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ERRATA

Page 190, paragraph 1, line 10, portions should read portion

" 192, 1st sub-heading, DESEASE should be DISEASE

" " , paragraph 3, line 8, insert cane between the and yield

" " , " " " 9, cross out cane after sugar

" 195, " 1, " 9, Kuntel should read Kunkel

" " 2nd footnote, name should read names

" 197, paragraph 2, line 8, seedlings should read seedling

" 198, " 1, " 17, prove " " proved

" 199, " 5, lines 1 & 2, take out the two commas, and the phrase in addition to should read and the use of

" 204, " 1, line 2, diseases should be fungi

" 205, " 1, " 2, can should read cane

" 209, " 1, " 4, Cagayan should read Cayana

" 215, second citation, Medella should read Medalla

" 216, fifth " place a comma after canes

" " thirteenth " " " " " Vegas

" 219, second " agricuture should read agriculture

" 249, first line, second paragraph, bettle should read beetle

" 250, " " third " bettle should read beetle

" 251, scientific name following title of article, generic name should read Plutella instead of Putella

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THE MOSAIC DISEASE OF SUGAR CANE *

By Gaudencio M. Reyes

The mosaic disease of sugar cane has long been the subject of critical study by many leading investigators of the world, but most of the original papers dealing with this disease published in the past are inaccessible and some are largely technical. For this reason this treatise is now presented in the hope that it will be of more practical benefit to the Philippine sugar-cane planters, as making available knowledge of the aspects of great concern to them, and giving additional data or information not yet generally known about the disease in these Islands, that are, in part, the fruit of the writer's experiences and observations. In a sense this is also an endeavor to survey the literature of the mosaic situation in the world, but it is impossible to get together all the views brought out in any one article. It is desirable that the cane growers should get the current information in due time so that they can take action promptly. But because of the rapid development of the investigations on this disease, some of the views expressed and data presented herein, and naturally the list of literature, will undergo changes. Although the disease has been extensively investigated, there still remains a fertile field for improving the mosaic situation.

HISTORY AND DISTRIBUTION

A sugar-cane malady which has caused considerable interest in these Islands for the past few years, among cane planters and the local cane pathologists in particular, is the so-called yellow stripe disease, also known as the mottling disease, or mosaic disease. Its distribution is widespread, it being prevalent in nearly all the sugar-cane-growing countries of the world, both in tropical and temperate regions.

The yellow stripe disease of sugar cane was first recognized in Java as early as 1890, where it is called by the Dutch "gelestrepenziekte." Subsequently it was reported from the Hawaiian Islands, Egypt, the Philippine Islands, Porto Rico, Cuba, the southern United States, the Argentine, Trinidad, Barbados, the Dominican Republic, Jamaica, Brazil, the Virgin

* Received for publication June 6, 1927.

Islands, Fiji, Formosa, New Guinea, Demerara, Surinam, Mauritius, Natal, Kenya Colony, Australia, Haiti, St. Kitts, Nevis, Antigua, St. Croix, India, Ceylon, Reunion, and Martinique. Mosaic was introduced into Mauritius but prompt action easily eliminated it there. According to a very recent report on sugarcane diseases in Mauritius (*The International Sugar Journal*, Vol. 28, No. 332, August, 1926), mosaic is believed to be entirely stamped out. Doctor Reinking of the United Fruit Company mentioned, in 1919, a yellow stripe disease of sugar cane in southern China, but as no adequate description was given its identity is somewhat doubtful.

While the disease was first observed here by Doctor Lyon about 1910 or 1911, according to Messrs. Lee and Kopke, and was probably present here much earlier, or long before it was first reported, it did not assume any great importance until the latter part of 1920, or not until it occasioned noticeable losses. Since then an investigation has been made and it is now known to be widespread. It has been found in practically all sugarcane regions, having been first reported from Rizal, Laguna, Batangas, Bulacan, Pampanga, and Occidental Negros, and later from Ilocos Norte, Tarlac, Bataan, Mindoro, and Samar, while very recently it has been identified on native varieties from Cavite and Zambales. There is little doubt that a more thorough and extensive reconnoitre will reveal its distribution in many other localities.

How the disease gained a foothold here is not definitely known, but the writer is inclined to believe that it was probably implanted through the constant introduction of cane varieties for propagation by various Government institutions and by private individuals previous to the enactment of our quarantine laws. There is an authenticated report that the disease originated in Java and was disseminated to other countries either directly or indirectly. Because of our proximity to Java, the disease might have been introduced from that country. This belief is further substantiated by a historical record that the fist shipment of sugar cane came probably from Java.

APPEARANCE OF THE DISEASE

The main thing for the cane planters to do is to learn how to detect mosaic disease in the field. The signs of the disease described herein are mostly those noticeable on the common native varieties. They are as follows:

Leaf symptoms.—When viewed from a short distance, the disease somewhat resembles a drouth injury. A careful scrutiny, however, discloses the presence of light yellow elongated streaks (stripes) running parallel with the veins of the leaves. They are visible on both the upper and nether surfaces in a similar pattern (plate XVI, figs. (*a*) and (*b*). The streaks, or sometimes blotches, are scattered profusely on the leaf blade, but occasionally they are more uniformly distributed on one side or section of the leaf blade than on the other. In size they vary greatly. Individual streaks are more or less regular in outline, but some coalesce either side by side or end to end and form irregular larger ones. The long streaks thus formed produce a striped effect. Some streaks surrounded by the normal green tint appear very conspicuous because of the contrast in color. These are very distinct on rapidly growing canes and on the young unfolded leaves where they usually appear throughout their length and breadth. Towards the tips of older leaves they are not easily discernible to the naked eye. Sometimes a few of the old lower leaves of an infected stalk appear healthy, but the writer believes that this is because the symptoms of mosaic have faded out. This seems to be the tendency of the disease on our Luzon White and Cebu Purple varieties.

On different varieties the mosaic pattern varies somewhat but in every case there are some characteristics in common. On Hambledon 426 and Cebu Purple varieties the streaks are somewhat more pronounced and more uniformly scattered, while on Negros Purple and Luzon White they appear more in blotches, and the streaks usually have somewhat dull ends in the latter. On older leaves of infected Luzon White and Cebu Purple varieties the symptoms appear as small, scattered, yellowish markings quite irregular in outline. Some are like dots or small spots while others are more nearly streaks (Plate XVII), with the green color predominating over the yellow. On mature leaves of mosaic-diseased plants elongated or irregular red spots (Plate XVIII) lying on or within the mosaic areas are common on Luzon White but rarely on Hambledon 426 and Cebu Purple. Whether or not these red spots are caused by the disease is not definitely known. No symptom of mosaic is visible on the leaves of very young shoots in new plant canes. In the dry season the leaf markings are not as conspicuous as in the wet months.

Stem symptoms.—Generally, on the upper portion of the stalk, longitudinal streaks or cankered areas appear on the rind. On

Cebu Purple they are of various shades of color; white or yellowish or both in the young stage of infection or when covered with leaf sheaths, and grayish white in old cases. The streaks on Luzon White are white or green on the upper internodes and reddish brown or ashy gray on the lower internodes. On the red and purple varieties these streaks are very plain (Plate XIX) although they are easily detected also on yellow varieties. On young plants of Cebu Purple they are visible even at the base. In severe cases of infection, the cankers are generally sunken, a shriveling of the upper portions of the stalk takes place, and the cane is generally pithy. Cracks have been occasionally observed on seriously infected plants of Luzon White, Cebu Purple, Sanduyungin, and Zambales canes. Due to the disease the plant is stunted, the internodes become short and slender, and sometimes shoots develop prematurely from the upper nodes of the standing cane. The retarded growth of the plant and the shortened internodes, however, cannot be considered as criteria for distinguishing the sugar-cane mosaic.

Internal symptoms.—By making cross sections of the diseased stalks more or less circular light yellowish, reddish brown to dark brown discolorations in the inner tissues have been observed by Doctors Matz and Lyon, and by other workers, and are said to be common on many varieties. And around these lesions or disintegrated tissues Doctor Kunkel, in Hawaii, found granular deposits; light yellowish in young tissues and brown in old tissues. In old cases, the entire inner tissues are light yellow in color. These necrotic masses, as they are called, are found oftener in the internodes than in the nodes. In the Philippines these symptoms in the inner tissues (Plate XX) have been corroborated by the writer's findings. On Luzon White canes about five months old, the inner lesions are hard and hollow in the center. They are commonly seen in the internodes close to the rind or to the cankered areas. When crushed under a microscope the disintegrated cells were found to contain minute hyaline granules. But for the present purpose it does not seem necessary to go into detailed discussion of this phase of the subject.

CAUSE OF THE DISEASE

Notwithstanding the untiring efforts of many eminent microbiologists and phytopathologists all over the world, mosaic is one of the diseases of plants the inciting agent of which still remains obscure. Various more or less reasonable hypo-

theses have been advanced regarding the cause of the sugar-cane mosaic, some of which are either inconceivable, or highly improbable. Attempts have been made to cultivate the causal organism to no avail, but various methods and devices have been, and are constantly being made, to successfully produce the organism in pure culture. Although the parasitism of the disease has been proved, no specific organism has been found constantly associated with it. Histological and cytological studies of the sugar-cane mosaic made by previous workers have disclosed the presence of plasmodial bodies or protozoa, but none of these were shown in a good many instances to warrant the formation of a definite conclusion. Some investigators believe that the disease is due to an extremely minute organism too small to be detected by even a powerful microscope and that can pass through the finest filter, hence the term "filterable virus." The infectious nature of the disease expresses strongly the belief that there is a living organism, but just what that organism is, still remains a scientific uncertainty.

In more recent times the existence of protozoa is the view held by some workers, since similar organisms have been found in the studies of tobacco, maize, tomato and other plants affected by mosaic. The fact that the mosaic disease of these plants is intertransmissible between plants belonging to different orders and families also makes it seem that there is a resemblance between the causative agent of the sugar-cane mosaic and that of other plants.

The filterable-virus (*contagium vivum fluidum* or contagious living fluid) theory has the most supporters. To Dr. M. W. Beijerinck,[1] the originator, we owe much of our present knowledge concerning the virus diseases which are found on many kinds of plants throughout the world. The microphotographic apparatus devised by Professor Köhler of Jena, Germany, and the use in connection with it of ultra-violet rays, it is hoped, will eventually solve this seemingly insolvable problem. Following this method, Doctors Frosch and Dahmen and Franz Schikora, also famous German scientists, succeeded in unraveling to the world the mystery of what was formerly called, "ultravisible or filterable virus," in connection with the study of bovine pneumonia and foot-and-mouth disease.[2] No inconsiderable amount of interest was aroused by this discovery and the reported success of the latter scientist, which may add to what is now known of the causal agent of the sugar-cane mosaic.

[1]Cited by Dr. L. O. Kunkel. [2] Cited by A. H. Rosenfeld.

Although the real cause of mosaic is not yet discovered, judging from the present knowledge of the disease, if it should be, there would probably be little change in the present methods of control.

LOSSES FROM MOSAIC DESEASE

Mosaic is the most widespread disease of the sugar cane and may be regarded as the worst. It has caused considerable reductions in sugar-cane yields in Louisiana and other countries and has threatened to paralyze the industry in Porto Rico and Cuba. Generally the effect of the disease is merely to stunt the plant, but Messrs. Lee and Kopke observed in the Philippines that some plants succumbed to it. The extent of infection made by the writer by actual counts on Cebu Purple has run up to 30 per cent, and on Luzon White to 56 per cent. By planting cuttings or points from diseased cane plants the infection may run to as high as 100 per cent. The presence and abundance of aphids are, to a large extent, also responsible for high rates of infection.

According to the histological studies of Doctor Cook and others, the disease destroys the coloring matter of the leaf leaving it yellowish and the ability of the plant to produce sugar is consequently lessened. Observations upon mosaic have shown that the disease causes a considerable reduction in the yield of cane and also in the sucrose content. Mr. Silvestre Asuncion of the Bureau of Agriculture calculated an average reduction of 61.28 per cent in the yield of Negros Purple and a decrease in the yield of sugar cane per hectare of 70.63 per cent. In other countries equally as high estimates of the losses have been recorded.

OTHER HOSTS

Mosaic has a great variety of suscepts and is transmissible among host plants of widely different species. It is found on many cultivated and wild grasses and Miss Wilbrink speaks of the prevalence of mosaic on both wild and cultivated plants belonging to 13 families. In the United States, Doctor Brandes of the Department of Agriculture found several relatives of the sugar cane that are attacked by the sugar-cane mosaic or a disease identical with it. Some of the susceptible grasses listed by Doctor Brandes are corn (*Zea mays*), sorghum (*Holcus sorghum*), pearl millet (*Pennisetum glaucum*), crab grass (*Syntherisma sanguinalis*), yellow foxtail (*Chàetochloa lutescens*), Panicum (*P. dichotomiflorum*), wild sugar cane (*Saccharum narenga*), bull-grass (*Paspalum boscianum*), barn

yard grass (*Echinochloa crusgalli*) and giant foxtail (*Chaetochloa magna*). In Hawaii, Doctor Kunkel reported Sudan grass (*Andropogon sorghum sudanensis*), Tunis grass (*Andropogon* sp.), Wonder forage grass (*Andropogon sorghum virgatus*) and Guatemala grass (*Tripsacum laxum*), as some of the cultivated hosts subject to the mosaic. Lately, Mr. Lee observed further in Hawaii other grasses which are attacked by a disease resembling the sugar-cane mosaic. They are crab grass (*Syntherisma pruriens, S. sanguinalis,* and *S. debilis*), foxtail (*Chaetochloa verticillata*), goose grass (*Eleusine indica*), and paddy grass (*Echinochloa colonum*). The disease also occurs on many grasses in Cuba, Porto Rico, and Natal. Some of these grasses were found to transmit mosaic to sugar cane or vice versa through insect carriers. The presence, therefore, of these sources of infection and of the insects which transmit the disease complicates in some way the problem of controlling the sugar-cane mosaic in those countries.

We have also many cultivated and wild grasses allied to sugar cane in this country, but only very limited observations have been made of their behavior to mosaic. Some of them are found growing adjacent to or in sugar-cane fields and should be looked upon with suspicion, as some of them have shown themselves to be dangerous sources of infection to the cane in other countries. A number of forage grasses have been introduced, cultivated, and propagated by the Bureau of Agriculture in various parts of the Islands for distribution purposes. Among these grasses are Napier, Guinea, Guatemala, Para, Tunis, Dallis grass, Uba cane, molasses grass, Merker, Jaragua, Zacate blanca de Honduras, *Pennisetum setosum, Panicum hirsutissinum,* billion dollar grass, Sudan, Rhodes, Natal, wonder forage grass, Cayenne, Colorado, Teff, Australian river grass, Kaffir corn, and Illinois broom corn.[1] The cane planters or those who are growing any of the above-mentioned grasses, and others, for feeding work animals should be on the lookout for the appearance of the mosaic on them, as well as the prevalence of the corn aphis.

Typical cases of corn mosaic have been seen in several parts of the Islands. On sorghum, which is also as commonly affected by mosaic as corn, a suspicious chlorotic condition of the leaves was once observed in Alabang, Rizal Province, although it could not be definitely charged to mosaic. The forage grasses in Manila, such as Guatemala grass, Guinea grass, Napier grass, a species of *Paspalum*, and Uba cane showed no

[1] The Philippine Agricultural Review, Vol. 18, No. 1, pp. 3–31.

symptoms of mosaic, the reason probably being that these grasses are almost isolated and that the sources of infection are practically negligible. In Cabanatuan, Nueva Ecija, the Guinea, Napier and Guatemala grasses observed in April, 1926, also showed no signs of mosaic disease.

Of the common forage grasses indigenous to the Philippines, we have Barit (*Leersia hexandra*), Batad-batadan (*Andropogon halepensis* var. *propinquus*), Daua (*Setaria italica*) and others, on which there have never been observed any mosaic symptoms. No signs of mosaic have been encountered on Tigbe (*Coix lachryma-jobi* nor on Tigbao Mestiza.[1] The importance of watching these grasses, however, cannot be overestimated.

There are also other plants which have been found to be free from mosaic and such plants may be grown near, or interplanted with sugar cane. Among them Doctor Brandes mentions rice, wheat, oats, Teosinte, timothy, red top, Job's tears (adlay), Para grass, Napier grass, Johnson grass and edible bamboo. In Hawaii, some of the common grasses such as Hilo grass (*Paspalum conjugatum*), red top (*Tricholaena rosea*), Bermuda grass (*Capriola dactylon*), Buffalo grass (*Stenotaphum secondatum*) and Panicum grass (*Panicum barbinode*) have been declared by Mr. Lee to be mosaic-free. In Porto Rico, Cuba and Natal there are also grasses which show immunity or only slight susceptibility to mosaic.

In the absence of the corn aphis, grasses which show evidence of mosaic are not risky sources of infection to sugar cane. Corn, sorghum, Sudan grass and Tunis grass are common hosts of mosaic in other countries upon which the corn aphis breeds abundantly. Such plants are dangerous to grow near sugar cane, as they serve as sources of infection and thus perpetuate the disease.

TRANSMISSION OF THE DISEASE

Insects are a common factor in disseminating contagious diseases. Previous investigators of mosaic disease have found that some sucking insects are responsible for its transmission from a diseased plant to a healthy one. Doctor Brandes, in the United States, reports that aphids and leaf hoppers could transmit the mosaic disease of sugar cane. He used a corn aphis (*Aphis maidis*) and a cane leaf hopper (*Tettigonia sp.*) and positive results were obtained. But on account of the limited tests he carried on with the cane leaf hopper, his results can not be

[1] Tagalog names, Philippine dialect.

considered conclusive. On the other hand there is a strong belief that the mechanical transmission of mosaic is not restricted to the corn aphis. In Porto Rico, mosaic disease was transmitted to healthy plants in the open field by the use of a plant louse, *Carolinia* sp. nov., or "Coqui" louse. In a preliminary report, Doctor Ledeboer [1] succeeded in infecting healthy plants in Java by using the sugar-cane aphid (*Aphis sacchari*), but in a later article he said that his work was not conclusive. Doctor Kuntel, in Hawaii, also failed to show that the sugar-cane aphid transmits mosaic. Similar experiments carried out in Hawaii, Cuba, Java, Porto Rico, the Argentine and Jamaica have proved conclusively the transmissibility of the mosaic disease through the agency of *Aphis maidis* to normal plants. There are in these Islands several kinds of insects which multiply on sugar cane but, as far as the writer is aware, no attempt has been made to show just which of them transmit mosaic.

The corn aphid is found on a great number of plants subject to the mosaic disease and plays the chief rôle in the dissemination of the disease. Dr. O. H. Elmer says that *Aphis maidis* Fitch. attacks 17 species of plants including dicots and monocots. The favorite hosts of *Aphis maidis*, besides sugar cane that easily contract the mosaic disease, are maize and sorghum. Two forage grasses, Sudan grass and Tunis grass, are also easily affected by mosaic and are host plants of the corn aphis in Hawaii. In Java, Doctor Wilbrink says that the corn aphis also feeds on Daua (*Setaria italica*), and on wild sugar cane or talahib [2] (*Saccharum spontaneum*) which is present here in abundance almost anywhere, growing in and near cane fields.

Mosaic is transmissible among host plants of widely different species. In the United States and Hawaii, Doctors Brandes and Kunkel, respectively, reproduced mosaic disease by artificial inoculation; *i. e.*, by extracting the juice of mosaic-diseased plants and injecting it into sugar cane or other grasses. Doctor Elmer succeeded in cross-inoculating the mosaic disease between plants of different orders and families by artificial infection and through the agency of insects. Infection of tobacco and tomatoes from sugar cane has been successfully carried on, but it has also been demonstrated that the infection between families was more difficult of execution and took a longer time than between hosts of the same family. Mosaic diseases of

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[1] Cited by Dr. E. W. Brandes. [2] Tagalog name, Philippine dialect.

the *Gramineae, Solanaceae Leguminosae, Cucurbitaceae,* and *Compositae* are intertransmissible according to the same author. The optimum condition for the infection of mosaic is an unchecked, vigorous growth of the plant, he further states.

There are conflicting arguments as to the transmissibility of the mosaic disease of sugar cane through the air. Prof. S. F. Ashby claims that aërial transmission takes place, and C. G. Hansford believes it is probable, while other investigators say it is highly improbable. In the writer's opinion, the disease might be transmitted by typhoons through mechanical injuries caused by the whipping about of the leaves.

The disease is not transmitted through the soil. Replanting diseased stools with points or cuttings obtained from healthy plants does not engender the disease. It is believed therefore that the causative agent does not thrive in the soil.

Seed canes obtained from infected plants almost invariably produce diseased stools, but Doctors Brandes and Klaphaak have demonstrated that true seeds of mosaic-diseased corn, sorghum, and wild grasses (crab-grass, bull-grass, and *Brachiaria platyphylla*) produce healthy plants. Their work on the transmissibility of mosaic disease by true seeds did not include sugar cane, but that the disease is not seed-borne has been sufficiently shown by workers in Java by the production of healthy seedlings from mosaic-diseased parents. Therefore mosaic disease can be controlled very much easier by planting cane fields with cuttings from plants reared or propagated from seeds, and new cane varieties can be safely introduced here without the danger of introducing the mosaic with them. However, plants produced from true seeds should be well protected from outside infection. In Hawaii, Mr. Lee confirmed the nontransmissibility of mosaic in the progenies by planting true seeds of mosaic-diseased Tunis grass and Sudan grass. Professor Ashby also believes that the sugar-cane mosaic is not seed-borne. Dr. G. W. Freiberg reports that mosaic diseases are not transmitted by seeds.

DEGREE OF SUSCEPTIBILITY OF SUGAR CANE VARIETIES TO MOSAIC

Some varieties of sugar cane get the mosaic disease easily while others are hardly, if at all, attacked by it. A Japanese cane called Uba, which is of little commercial value except as forage in Hawaii and in this country, is generally conceded to be an immune variety. As a matter of fact, prior to 1925, it was found so in all the countries where it is extensively

grown. Uba, however, cannot be grown to much advantage because it is not a very desirable commercial variety and matures late. Another objectionable quality is that it mills badly.

It is of the utmost importance for the planters to know what varieties to plant in order to save themselves from heavy losses due to this disease. Keen observation is therefore essential because a variety of cane may be easily affected by mosaic in one country and not be so in another. For instance, the Yellow Caledonia and Bourbon varieties were severely attacked in the West Indies, while in Hawaii they were more resistant. Some of the Java seeddling varieties which are losing in popularity in that country proved of great value in other countries. In Louisiana and Argentina, Java (P. O. J.) 36 and 213 proved tolerant [1] to mosaic. Both varieties are heavy yielders and are the most popular ones grown in the Argentine. The behavior of these two varieties towards mosaic has not been determined as yet in these Islands. In Java they are liable to mosaic. The same is also true as to different localities in the same country, or under different environmental conditions.

A great number of cane varieties are susceptible to the disease and practically all varieties are attacked by it in varying degrees in the Hawaiian Islands. But by a systematic selection of healthy seed cane and the persistent use of resistant varieties the losses from mosaic in Hawaii have been greatly diminished.

For the convenience of the planters the following data have been prepared as to the reaction of cane varieties to mosaic in the Hawaiian Islands, the Argentine, Java and the United States, and also from our experience in the Philippines. In Hawaii, Doctor Kunkel observed that the varieties Lahaina, D117, Striped Tip and Yellow Tip, were very susceptible to it, while D1135, Yellow Caledonia, Badila and H109 were classed as resistant in the order named. In the Argentine, some of the varieties which proved highly resistant are P. O. J. 36, P. O. J. 213, P. O. J. 826, P. O. J. 979, P. O. J. 1228 and P. O. J. 2379, while T. J. E. P. 24, P. O. J. 2714 and P. O. J. 2725 are practically immune. In Java, the most resistant varieties are P. O. J. 100, P. O. J. 2878, 247B, EK 2 and EK 28. In tests conducted by Doctor Brandes in the United States, the following varieties proved immune: Kassoer, Tjepiring 24, Toledo, Uba, Kavangire, Cayana 10, Merthi, Kinar, Oshima and Yontanzan, and P. O. J. 2714,

[1] Tolerant means that the variety readily takes the disease but is little affected by it.

P. O. J. 2725, P. O. J. 2727 and D1135 were resistant, while P. O. J. 36, P. O. J. 100, P. O. J. 213, P. O. J. 228, P. O. J. 234, P. O. J. 826, P. O. J. 979, P. O. J. 1228 and P. O. J. 2379 were tolerant. In these Islands, observations made by the writer of some native and exotic varieties of sugar cane showed that Luzon White, Negros Purple, Cebu Purple, Pampanga Red, Louisiana Striped, Inalmon, H69, Malagache, New Guinea 40, Cheribon, Hambledon 5, Big Tanna, and Hambledon 426 were susceptible varieties, while Badila, D1135, Java 247, H109 and Yellow Caledonia were resistant varieties. Great resistance was also demonstrated by the varieties Lahaina, New Guinea 24A, New Guinea 24B and Uba in recent tests conducted in Pampanga by the Pampanga Sugar Mills. It is reasonable to assume, however, that some of these varieties may prove otherwise under different environmental, soil, and climatic conditions and in the presence of other factors favorable for the development of the disease. For example, Louisiana Striped prove resistant in the tests conducted by the Pampanga Sugar Mills at Del Carmen, while under Manila conditions it was found to be susceptible. Further variety tests will demonstrate the behavior of other varieties to this disease. The Philippine College of Agriculture has produced some improved varieties of which C. A. 12735 and C. A. C. 87 have shown great resistance to mosaic.

Doctor Brandes, while in the Philippines in 1923, discovered a variety of cane at Del Carmen, Pampanga, which was immune to mosaic disease. It was produced from a cane point and was called Toledo cane after Don Roberto Toledo, the owner of the hacienda. It is reported that this cane resembles D1135 in many respects. Later, Doctor Roxas of the Philippine College of Agriculture reported that it had proved to be not entirely immune to mosaic.[1]

In a very recent paper it is stated that the well-known varieties of the slender type hitherto reported as immune have been observed to have a slight susceptibility to mosaic in the United States. According to Dr. P. A. Yoder's observations, in 1925, of the reaction of sugar-cane collections including the supposed immune varieties, to mosaic in the States of Georgia, Louisiana, and Florida, the order of resistance is as follows: Cayana, Uba, Tekcha, Kavangire, Khera, Chikucha, Yontanzan, Oshima, Kikaigashima, Old Small Japanese. On account of the rareness

[1] From a talk in the Fourth Annual Convention of the Philippine Sugar Association, Manila, P. I. September 8, 1926.

of mosaic cases found in these varieties, and the slight effect on the growth of the plant, however, he recommends roguing as a practical means of eliminating the disease. In spite of this sudden incidence, the same author stated further that it should not have a serious significance in the commercial production of sugar cane, and, in so far as tonnage goes, and for reasons of expediency, they may still be regarded as immune.

There are still certain varieties which are in the category of immune varieties, such as Kassoer, Tjepiring 24, Merthi and Kinar. These four varieties have not, as far as all available literature is concerned, shown any sign of mosaic whatever. Artificial infection experiments conducted by Doctors Brandes and Klaphaak failed on the latter two varieties.

CONTROL MEASURES

Our experience as well as that of foreign countries shows that in the sugar-cane fields where no effort is made to control mosaic disease, it becomes rampant. So as soon as the disease is noticed control measures should be taken and carried out meticulously and continuously to a successful termination. There is no cure for this disease.

The following control or remedial measures are here enumerated in order to show the planters what progress has been made in combating the disease and at the same time the feasible measures they should adopt. The various methods of control are treated for convenience separately in order that the reader who is interested in any one of them may readily obtain the information he desires. For the successful control of this disease, either a single method or else a combination of two or more methods may be necessary, depending on conditions.

Careful attention to the following principles, in addition to good ordinary agricultural practices, will do much to control the disease as it will not have a serious effect on vigorously-growing canes.

1. *Quarantine.*—The importation of sugar-cane materials here for planting purposes from without is restricted by Administrative Order No. 32, issued December 5, 1923. Since the sugar-cane mosaic is already present in many localities while in other places it is not known, care must be taken to exclude it from the noninfected places.

Exclusion is a very economical and simple measure. The spread of the disease can easily be prevented by a careful selection of introduced canes by competent men. All imported canes

should be grown first for at least two seasons, or one plant crop and one ratoon crop, in an absolutely isolated place, preferably under glass, under the direct supervision and constant inspections of a cane pathologist and a cane entomologist, before they are released or distributed for propagation. Incidentally this would prevent the introduction of insects likely to act as disease carriers also.

2. *Selection of seeds.*—It is now a well-established fact that the disease is transmissible by propagating diseased points or cuttings. This is termed primary infection. If cuttings of diseased plants are planted it becomes more and more virulent. Selection of tops or cane seeds should be undertaken with the utmost care, and only by trained men who can readily distinguish the mosaic-free plant from a diseased one. It is always advisable to secure seed cane from disease-free fields, but if no such cane fields are available, selection may be done elsewhere in a field where the injury is least and before cutting the cane. Seemingly healthy individuals from a diseased stool will sooner or later yield diseased plants. But however carefully the selection is done in an infected field there is always the danger of picking some plants which appear to be normal or clean, but which later, when planted, will develop the same disease. This makes selection extremely difficult and even those who are experts in this line are sometimes deceived. In such cases it is necessary to plant the cuttings first in an isolated nursery. Such a phenomenon is denominated "latent infection" and stools produced from them should be replanted at once. A wise policy to follow is to use cane seeds of known origin. Also, it is feasible to carry out seed selection in a field or locality where insect transmission or secondary infection is light or absent. This practice may gradually eliminate the disease as was done with the potato mosaic in Scotland.

Selection increases the yield. In other countries nurseries of healthy plants are maintained in isolated places, on high land, or near the seashore on the windward side of an island; and some growers make a business out of selling their healthy plants for seed. Very little attention is paid to seed selection in this country. The usual practice is to save the tops of canes sent to the mill for seed purposes. This procedure results in the perpetuation and cumulative effect of diseases.

In Porto Rico, it is claimed that the selection of varieties resistant to mosaic coupled with the selection of varieties with

high sucrose content are the two main contributing factors towards a substantial increase in production of sugar in her 1925 and 1926 crops over the average production of the preceding decade, or an increase of 43.42 per cent.

3. *Resistant and immune varieties.*—The method which has proved the simplest and most economical and successful in combating plant diseases is the substitution of resistant or immune varieties. This has been and will probably continue to be the most essential measure for fighting the sugar-cane mosaic. The selection of resistant varieties, however, should be guided by local conditions. In other words, the suitability of a variety to existing conditions is of prime consideration. Also the sucrose content of any resistant or immune variety, as well as the other important factors from the standpoint of sugar production, should not be overlooked.

In Java, Hawaii, Porto Rico, Louisiana and other countries success has been attained in reducing the ravages of the sugar-cane mosaic by the use of resistant varieties coupled by seed selection. In the experiments conducted by Doctor Kunkel in Hawaii, D1135 proved the most resistant to mosaic and showed a capacity to endure the disease and ability to recover even if infected. Doctor Brandes reported some Japanese canes which are immune to mosaic; namely, Uba, Kavangire, Zwinga, Cayana 10, etc. Lately, however, these and other varieties believed to be immune have proved to be not entirely so. However, there are still other varieties of this type which are considered immune. Whether or not they rank with the best existing commercial varieties, it is always profitable to use them in lieu of the more susceptible varieties, if infection becomes severe, as has been proved by the planters of Porto Rico, Cuba, Natal and Jamaica who have replaced their susceptible canes with Kavangire or Uba. At present, however, the exclusive planting of these slender varieties in the Philippines does not seem advisable. Although Uba has some weaknesses, for reasons of expediency or in times of depression, it could be profitably utilized. Besides its outstanding quality of great resistance to mosaic, it also possesses some peculiarities which make it superior in some respects to other varieties. It is resistant to drought, practically immune to other cane diseases, resistant to pests, ratoons well, tillers heavily, and can thrive in poor soils. In like manner the sugar industry in the Argentine was saved from the disastrous outbreaks of mosaic by the substitution of tolerant

Java hybrids, as P. O. J. 36, P. O. J. 213, P. O. J. 2725, P. O. J. 2714, and T. J. E. P. 24.

Dr. G. Wilbrink of Java, while in the Philippines in June, 1926, recommended the planting of two good Java cane varieties, P. O. J. 2714 and P. O. J. 2725, which she says are very resistant to mosaic and have the ability to withstand and overcome the disease as they mature, if they become infected when young. In the Argentine they proved also to be practically immune. Such desirable varieties, as well as D1135 and others which are not easily affected by mosaic, should be widely and persistently used. According to the Bureau of Agriculture records, these Java seedling varieties have been recently introduced here from the Korisho Nursery, Formosa, by Mr. L. Weinzheimer, vice-president and general manager of the Calamba Sugar Estate, Laguna, and the Pampanga Sugar Mills, Del Carmen, Pampanga. Dr. N. B. Bach of the Hacienda Cabugcabug, Pilar, Capiz, has also introduced some varieties from the Sugar Experiment Station at Pasoeroean, Java, of which, according to Mr. S. Asuncion, in a verbal report to the writer, P. O. J. 2727, P. O. J. 2878, DI 52 and EK 28 are doing very well. Mr. Jose Guevara, also of the Bureau of Agriculture, who went to Pilar in December, 1926, reports that EK 28 is capable of producing 200 piculs to the hectare under Capiz conditions. These promising varieties need to be tested out here for some years, however, in order to determine exactly their resistance or susceptibility.

4. *Eradication.*—Elimination must be done as soon as infected plants are noticed. All diseased plants should be dug up and burnt, or buried very deep in the ground as is done in Java, before giving the insect carriers of mosaic a chance to move to the healthy plants. Sometimes the aphids hide in the folds of the outer leaf sheaths and in this way they may escape detection. In our experience, the former practice has considerably lessened the time and labor expended in eradicating the disease, especially in isolated places. This method, however, is feasible only so long as the per cent of infection is low, or about 10 per cent, and when the area is small. It has to be done every 22 days in order to cover the incubation or latent period safely, which lasts about three weeks, and repeated two or three times thereafter. The rogued out plants must be replanted. It is not advisable to extend roguing and replanting too long because the plants will not mature uniformly for the milling season. Besides, inspection, roguing, and replanting cost a good deal in time and money. Some experienced planters

in Jamaica plant their canes close in the row to lessen the time spent in replanting. In other countries, where the aphids are abundant, sometimes roguing proved disappointing because of secondary infection. If this happens, the insects should be destroyed by chemicals. If the insects cannot be controlled then roguing becomes futile.

In case a field is very badly infected the plants should be allowed to mature for the mill. Burn all plant trash after harvest. This would incidentally get rid of many insects responsible for the transmission of the disease. The field should be plowed thoroughly and harrowed and all living plants or portions of canes of the preceding crop should be removed and destroyed. Sufficient time should be allowed for the portions of the canes that have been buried to shoot up, so that all plants can be destroyed before replanting. The new crop should be selected from stocks free from disease. As can be seen eradication entails much care, patience, and expense. The gain, however, outweighs the expenses of replanting and the spread of this dangerous disease. Its success depends entirely upon the interest and coöperation of all concerned. It must be thorough and widespread to minimize the risk of reinfection from neighboring cane fields. In some countries there are eradication laws.

5. *Ratooning.*—Diseased cane fields should never be ratooned, because ratooning perpetuates the disease and becomes a source of infection into new and uninfected fields. Plants produced by ratooning are usually weak and yield less in comparison with plant crops.

6. *Disinfection.*—Doctor Brandes tried an experiment in seed treatment, using Bordeaux mixture or corrosive sublimate solution and the results showed that disinfection is not practical.

Hot water at 50–52° C. for 30 minutes, and at varying degrees of temperature and length of immersion have been tried in some countries against mosaic but it failed to cure the diseased cuttings. However, the treatment killed many insects like borers and stimulated the growth in some instances.

In Porto Rico, as cited by Doctor Roxas of the Philippine College of Agriculture, good results were obtained in preventing the spread of cane diseases by the use of lime water. The cane seeds were soaked, just before planting, for 24 hours in this solution made by dissovling one shovelful of lime in one "caua" of water. The efficacy of this or other seed treatments for mosaic remains to be proved by further experiments. At

least disinfection is beneficial in destroying the spores or vegetative parts of some cane diseases, and pests which may happen to be carried by the cane seeds.

7. *Use of fertilizers.*—Concerning the use of fertilizers to minimize the effect of the disease, Doctor Stevenson of the Department of Agriculture, Porto Rico, says: "While they (the experiments) show clearly the value of fertilizers, often resulting in as high as fifty per cent gain in yields, there never has been the slightest evidence that there was any effect in controlling, or even checking, mottling." Liming the soil and the use of such fertilizers as ammonium sulphate, green manure, filter press cake, lime in different combinations as well as standard complete fertilizers, together with good tilth, have been tried against the disease.

Considerable fertilizing of sugar cane has been done in these Islands and with but a very few exceptions increased production resulted. But only a very limited amount of observation and experimentation has been tried to show the relation, if any, of fertilization to mosaic disease. According to Lee, *et al.*, in a letter of Dr. Oakes Ames of Harvard University to the Bureau of Science in 1920, "Nitrate of soda applications in Cuba seemed to have a favorable effect in lessening the disease but his statements were based on field observations only and not upon careful comparative experimental results." They mentioned further that Mr. John Dumas of the Calamba Sugar Estate reports the same effect on mosaic disease in the Philippines following the application of nitrate of soda.

In San Carlos, Occidental Negros, Mr. Lee accidentally found out during his fertilizer experiments with respect to yield that ammonium sulphate considerably reduced the ravages of mosaic. Mr. G. H. Pritchett noted in Isabela, Occidental Negros, that by planting mosaic cuttings and fertilizing with ammonium sulphate at the rate of 250 kilograms to the hectare the yield increased by 12.55 per cent in tonnage and 19.30 per cent in sugar in the treated plots.

Nitrogenous fertilizers of 10–6–2 composition are recommended for sugar cane and such fertilizers available in the market under various trade names, as the following, having this proportion of nitrogen, phosphoric anhydride and potash, should be tried in connection with mosaic experiments: Big Crop, Corona No. 1, Sumatra Superior, Estrella No. 1, CCM No. 1, Swift's Red Steer, A.B.C., Estrella No. 4, Pamco No. 1, "Double Crop," Arado No. 1, Best Brand Organic Fertilizer, etc.

8. *Elimination of weeds.*—Clean culture is essential. All weeds or plants related to sugar can that are subject to the attack of mosaic, or a disease identical to it, and are food plants of the aphid, must be destroyed by burning to do away with the sources of inoculum, or the risk of secondary infection. Interplanting with cultivated plants subject to mosaic should not be done unless the sugar cane is an immune variety. The destruction of the weeds would also incidentally get rid of many insect carriers of mosaic, especially if effected after the eradication of mosaiced canes. It has been reported from the Pampanga Sugar Mills that through cultivation of the cane fields and disturbances of the weeds, the aphid is driven to the cane and spreads the disease.

9. *Disease carriers.*—Some kinds of sucking insects have been proved to be media for the dispersal of the disease. In this country quite a number of insects have been found to breed or feed on sugar cane, but of these only the leaf hoppers, mealy bugs and aphids are possible carriers of the disease. What should concern the planters most is the corn aphid, which is already definitely known to transmit mosaic. According to Doctor Brandes, the corn aphid, has been observed on sugar cane in practically all sugar-cane countries of the world. Maize and sorghum should not be grown near sugar cane because these plants are the most common hosts of the corn aphid, and are host plants of the mosaic disease.

On a small scale, Mr. Otanes, entomologist of the Bureau of Agriculture, recommends the use of soap solution as a spray in the proportion of ½ kilo to 40 liters of water. Nicotine sulphate and nicotine dusts are also effective against the insects. A powerful duster of the type of "Bean" duster with improvements by the Oahu Sugar Company may be used to a great advantage. In cane plantations an aeroplane would be very advantageous to make a uniform distribution of the dust. The use of predators, particularly birds, and parasites, however, would be more effective and economical judging from the experience of other countries. In Cuba, according to D. L. Van Dine, the corn aphid is parasitized by a braconid, *Lysiphlebus testeceipes* Cresson and by a kind of fungus, and various predaceous insects feed voraciously upon them, as the coccinellids (Ladybird beetles) and syrphid fly larvæ. Beneficial insects like these should be introduced and allowed to multiply freely.

A method which might work successfully here to avoid secondary infection is that suggested by the result of an investigation

by Julio Alfaro in Cuba, whereby the sugar cane is planted at a certain period of the year so that the plants are sufficiently grown up and resistant to insect attack before the aphids become prevalent. The existence of a dormant period in the life of the aphids was confirmed by the findings of van Breeman in Java to be at the outset of the dry season and eventually ceasing altogether for months before the wet season sets in. This time, when the insects are in their dormant stage, is not yet definitely known here and presents an enticing field for future study.

10. *Breeding stations.*—Some work has already been done in hybridization and selection in this country, but more and more effort should be concentrated on the task of creating new varieties or strains, to obtain better and yet better varieties suitable to our local conditions and with the desired resistance or immunity to mosaic disease. There will be a demand for these varieties or strains as the highly resistant or immune varieties extant do not seem to entirely satisfy the growers.

It would seem expedient that either by the Government or the association of the sugar planters, or both in partnership, should establish a central breeding station with substations in the most important sugar-cane-producing provinces. The central station could plan the experiment and the substations do the actual work. Each substation could raise healthy stock of the varieties of sugar cane extensively grown in the province where it was located for distribution. The nursery stock would be grown from carefully selected individuals. The substations would be located in isolated places. It would be the ultimate object of these stations to produce varieties immune to cane diseases and of course to mosaic disease. Liberal financial aid and a sufficient number of trained men would be needed, of course, and the work would need to be under the direct supervision of a plant breeder in collaboration with a sugar-cane pathologist and a plant culturist.

The apparent immunity of some of the hard-to-mill canes like P. O. J. 2714 and C. A. C. 87 and the great resistance of some of the Japanese canes like Uba, Kavangire [1] and others to mosaic, suggest the possibility of producing superior or entirely immune varieties and of better milling quality but with sufficient fiber content by crossing them with some of our highly esteemed sus-

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[1] Some authors claim that Uba and Kavangire are synonymous and are, therefore, used interchangeably.

ceptible varieties. Some of the seedlings raised in Java are hybrids between the immune, or highly tolerant Indian canes to mosaic and some of the susceptible thick varieties. Mr. Asuncion of the Bureau of Agriculture told the author in September, 1926, he was getting good results along this line by crossing Java 247 with Negros Purple.

The selection of resistant individuals from which to breed pure strains should also be encouraged. There are many such plants which are awaiting detection. By repeated selection the resistance is increased and a resistant or immune strain may be secured.

Since the true seeds of mosaic parents do not transmit the disease to the offspring, work along this direction should be given great emphasis here. Many of the promising varieties resistant or immune to mosaic are seedling varieties. The nursery for this project should be well guarded from all sources of contamination, both from the plant breeder's and the pathologist's viewpoints. In the long run the results of breeding will probably be the most profitable outcome of the struggle against mosaic and other cane diseases.

SUMMARY

1. The mosaic disease of sugar cane was first noted in Java in 1890, and it now has a world-wide distribution. It has been extensively investigated. In the Philippines the first authentic report of the presence of mosaic was about 1910 or 1911. It is now found practically all over the Islands.

2. The most salient visible features of the disease are the elongated, light yellow streaks (stripes) on the leaves, particularly distinct in the young developing leaves, and the streaks or cankered areas on the stem.

3. In spite of the untiring efforts of many eminent investigators, no specific organism has as yet been found constantly associated with the disease. Thus far, all efforts to isolate the causative agent have been in vain. Evidences, however, seem to indicate that the disease is caused by a protozoa, or by a highly microscopic, living, filterable, and infectious organism.

4. Not an inconsiderable amount of loss has been sustained by outbreaks of the disease that have even threatened to destroy the industry in some countries. Although no complete data of the losses are available, as no thorough reconnaissance has been made, the disease has manifested itself in a quite alarming manner in these Islands.

5. The mosaic disease has a wide host range. Previous reports show that it is infectious and transmissible among host plants of the grass family and between families and orders. There are, however, some plants related to sugar cane which are not subject to attack by mosaic.

6. The corn aphis (*Aphis maidis* Fitch.) which is found throughout the sugar-cane world has been conclusively proved to be the chief factor in the transmission of the mosaic disease from diseased cane plants to healthy ones. Corn, sorghum, Sudan grass and Tunis grass are common hosts of mosaic and on these the corn aphis breeds abundantly. Such plants are risky sources of infection for the sugar cane.

7. Experiments point strongly to the fact that the disease is not seed-borne. In other words, it is not carried by true seeds. At least this is true of the mosaic disease of the grass family.

8. The transmissibility of the disease through the air is still a mooted question.

9. It is the trend of opinion that no transmission of mosaic takes place through the soil.

10. That the disease is incurable is the consensus of opinion.

11. The utmost care should be taken to exclude the disease from uninfected places. As a matter of precaution, all introduced varieties, which should not only be good yielders but possessed of some degree of resistance to the disease, should be grown first in an absolutely isolated nursery, preferably under glass, for at least two generations, or one plant crop and one ratoon crop before being used for propagation purposes. This work should be under the immediate supervision of a cane pathologist and a cane entomologist.

12. Tops or cuttings obtained from diseased plants invariably give rise to diseased stools. The disease sometimes masks its symptoms and quite often it is inadvertently propagated in this way. Great care must be taken in selecting seed canes.

13. The degree of susceptibility of sugar cane varies with different varieties. This reaction leads to the classification of the varieties into susceptible, tolerant, resistant and immune. There are only a few varieties which have so far proved immune; viz., Kassoer, Merthi, Kinar, and Tjepiring 24. Among the highly resistant varieties, as shown by experiments and observations in various countries, are P. O. J. 2714, P. O. J. 2725, P. O. J. 2727, P. O. J. 2878, P. O. J. 100, P. O. J. 36, P. O. J. 213,

P. O. J. 979, P. O. J. 234, P. O. J. 826, P. O. J. 1228 and P. O. J. 2379, and EK 2, EK 28 and 247 B, C. A. 12735, D1135, Yellow Caledonia, Badila, Java 247, New Guinea 24A, New Guinea 24B, and some slender varieties like Cagayan, Uba, Kavangire, and others.

14. As far as possible, eradication of the diseased stools should be undertaken as, in the long run, the expenses involved will more than compensate the expenses of replanting caused by the spread of this injurious disease.

15. Not enough work has been conducted towards the successful extermination of the aphis on sugar cane. Spraying with soap solution, nicotine dust, nicotine sulphate, and the use of predators and parasites are recommended for controlling it.

16. Ratooning should not be practised in diseased cane fields because it perpetuates the disease and lessens the yield.

17. Treatment of diseased cuttings with Bordeaux mixture, corrosive sublimate solution, hot water, etc., so far, has not proved successful in curing the disease.

18. No sufficient tentative work has been carried out on the effect of fertilizers against mosaic. Nitrogenous fertilizers of 10–6–2 composition, such as sodium nitrate and ammonium sulphate, are recommended for tests along this line.

19. All plants, both wild and cultivated, susceptible to mosaic should be exterminated, as they are sources of infection and at the same time harbor insects.

20. Selection and hybridization of sugar cane with a view to improving the existing varieties have been undertaken quite extensively in Java, the West Indies, the United States, the Philippines, and other countries, but more and more attention should also be paid to their resistance to mosaic and other diseases, and suitability to local conditions, and other desirable factors from the point of view of sugar production.

The following is a list of the available literature consulted in the preparation of this article. Any one desiring more detailed information concerning the disease should read some of these papers which are in the libraries of the Bureaus of Science and Agriculture. Some of the articles have appeared in two or more journals. For convenience they are arranged according to the date of publication. There is no claim that this is an exhaustive bibliographical list, but great pains were taken in gathering, as far as possible, the more recent papers on the subject. Abstracts or reviews of some of the original articles can be

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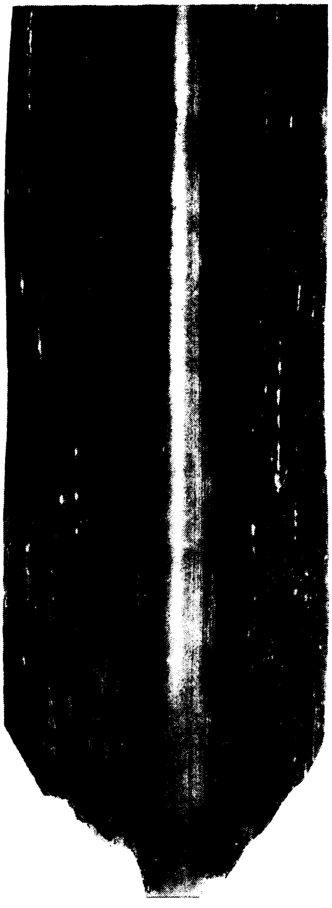
(*a*) Basal portion of a young leaf of Luzon White variety showing typical symptoms of mosaic disease on upper surface.

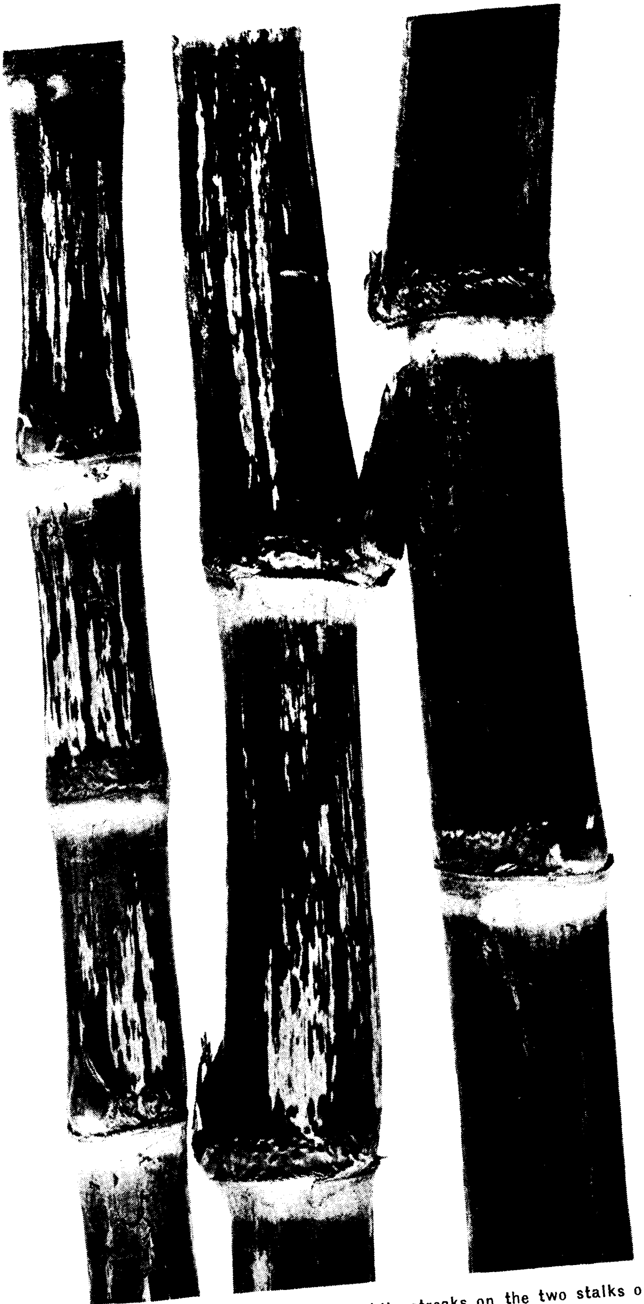


(*b*) Reverse side of same portion of leaf in (*a*) showing exactly the same markings.

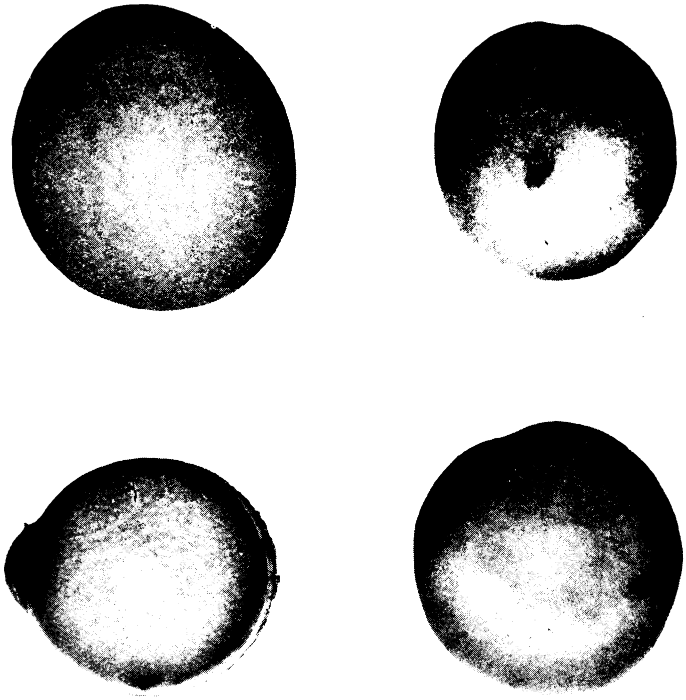
Symptoms of mosaic disease on older leaves of Luzon White variety

Portions of old leaves of Luzon White showing red spots (indicated by x) frequently associated with mosaic disease

PLATE XIX



The mosaic disease of sugar cane showing white streaks on the two stalks on the left compared with a healthy cane on the right. These were obtained from a field of a native variety locally known as Sanduyuñgin.



Cross-sections of Luzon White stalks showing lesions in the inner tissues as a result of infection by mosaic: Three diseased and one healthy. Slightly enlarged

A STUDY OF THE FLOWERING HABITS AND FLOWER CHARACTERISTICS OF DIFFERENT SUGAR CANE VARIETIES AT LA CARLOTA SUGAR CANE EXPERIMENT STATION.

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A knowledge of the flowering habits and flower characteristics of the different varieties of sugar cane for cross pollination is of prime importance to success in hybridization, as much time and energy may be wasted if proper attention is not given to the study of flowers. The weather and the time of day need to be observed closely in this kind of work as they are factors directly affecting the behavior of the flowers. The present investigation was conducted at La Carlota Sugar-cane Experiment Station, La Carlota, Occidental Negros, in connection with the hybridization work at the station. All the available varieties of sugar cane under culture during the flowering season of 1923–1924 and 1924–1925 were used in this work.

PAST WORK IN THE PHILIPPINES

Hines, C. W.[1] observed that the main branches in the central portion of the arrows produced the largest and the most perfect flowers, while those on the branches near the extremes were usually smaller and imperfect. The interval between the first appearance of an arrow and its complete emergence from the leaf-sheath was two to four days, while it required from two to three days after the flowers appeared for their organs to become sufficiently developed to begin to distribute pollen.

The following figures in Table I show the comparative efficiency of a number of varieties producing normal pollen as observed by Hines:

[1] The Philippine Agricultural Review, Vol. X, No. 1, 1917.

TABLE I.—*Comparative efficiency*

Well supplied	Poorly supplied	None
Louisiana Striped	Badila	Chinois
Lahaina	Mauritius Malagache	Inalmon
Hawaiian seedling–16	Demerara–95	Uba
Hawaiian seedling–20	Louisiana Purple	
Hawaiian seedling–27	Striped Singapore	
Hawaiian seedling–69	Negros Purple	
Hawaiian seedling–227	Luzon White	
Hawaiian seedling–309	Pampanga Purple	
Demerara–1135		
Rose Bamboo		

Paglinawan, Sergio B.[1] found on the College of Agriculture Farm at Los Baños, Laguna, that of the 44 different varieties examined, 30 varieties were well supplied with pollen. The remaining 6 (P.B. 7, P.B. 103, Mauritius Malagache, Negros purple, Badila and Formosa) were poorly supplied and eight of them had none. The eight were P.B. 104, P.B. 8, P.B. 105, P.B. 2, Chinois, Big Tanna, Natal Uba, and C.A. 16402. All those well supplied had open anthers. The color of the anthers was not found to have any significance as regards the pollen supply for the varieties Chinois, Uba, P.B. 105, P.B. 2 and C.A. 16402 which had no pollen, had purplish anthers like those of the varieties which had an abundant pollen supply. He also found that in the varieties P.B. 113, P.B. 114, P.B. 116 and C.A. 12797F2, the length of time from shooting to pollination was from 3 to 5 days only. In the other varieties it ranged from 7 to 12 days. In most varieties, pollination occurred from 7 to 10 days after the appearance of the arrow. It was also observed that the flowering season of the different varieties of sugar cane on the College of Agriculture Farm used in the experiment began September 15 and ended about December 5, a period covering approximately 30 days. The different varieties used varied in their time of flowering and the age at which they began to flower was also variable, ranging from 255 to 411 days. It is further noted that more cane flowers bloomed between 6 and 8 o'clock in the morning than at any other time of the day. The anthers began to dehisce at 6 o'clock in the morning. Only a certain number of stamens opened every day. In an arrow the opening of the anthers usually continued for successive days. The seeds of sugar cane differ in vitality as well as in viability.

[1] The Philippine Agriculturist, Vol. XIV, No. 2, July 1925.

MATERIALS AND METHODS

All the available varieties of sugar cane under observation at La Carlota Sugar-cane Experiment Station during the flowering seasons of 1923–1924 and 1924–1925 were used in this investigation. This work covered the following:

1. Behavior of the flowers.
2. Relative date and age of flowering.
3. Pollen supply.
4. Length of time from shooting to pollination to complete appearance of arrow and to ripening of seeds.
5. Vitality and viability of sugar-cane seeds.

OBSERVATIONS AND RESULTS

(1) *Behavior of the flower.*—The behavior of the flowers of all the varieties of sugar cane that were growing in the station during the period from 1923–1924 to 1924–1925 was carefully observed. It was found that there was no fixed time of the day for the sugar-cane flowers to bloom and the anthers to open as the flowering seasons were mostly rainy days in the station, but that generally when the flower became dry the anthers opened and dehiscence occurred immediately. Dehiscence did not occur while the anthers were wet. The flowers and stamens on the uppermost part of the arrow were the ones to open and dehisce first. Active pollination was observed during the clear part of the day.

It was observed that the seeds from the topmost part of the arrow ripened earlier than those from any other part of the arrow. This could easily be detected by the falling off of the seeds from that portion of the arrow first when the stalk was shaken by winds and others especially during clear days. The falling of seeds was frequent in sunny weather.

(2) *Relative date and age of flowering.*—Two season's (1923–1924 and 1924–1925) observations were made on the exact dates of flowering of the different sugar-cane varieties under culture in the station as plant-canes. The canes were planted side by side in the Sugar-cane Nursery No. 1 and in the Sugar-cane Nursery No. 2. Forty-eight and 61 varieties were used the first and second seasons, respectively. The date when the first arrows appeared was recorded and that date is considered as the date of flowering. The age of flowering was computed from the date of planting to the date of flowering.

Results.—The flowering seasons of sugar-cane varieties used in the experiment and the neighboring haciendas began Sep-

tember 24, 1925, and ended November 10, 1925. Other varieties, such as Uba, Luzon-3 and Luzon-4 did not flower at all. In 1923-1924, flowering began on October 20 and ended on December 22, 1924. Table II shows the observations made in 1923-1924 flowering season. Alabang-2 Alabang-3 were the earliest varieties to flower. Alabang-3 flowered in 335 days and Alabang-2 in 336 days, Louisiana Purple flowered last, in 411 days.

TABLE II.—*Relative date and age of flowering of different varieties of sugar cane (1923-1924)*

Variety name	Date planted 1923	Date of flowering 1924	Age
			Days
Alabang-2	November 19	October 21	336
Alabang-3	do	October 20	335
Alabang-5	do	October 28	343
Badila	November 5	October 23	352
Barbados	do	October 22	351
Barbados Striped	November 19	November 8	354
Big Tanna	November 5	November 14	374
CebuPurple	November 7	October 22	349
Cheribon	do	October 27	354
Chinois	November 16	November 26	375
C. A. C.-88	November 8	October 25	351
C. A. C.-89	do	November 6	363
C. A. C.-90	do	October 20	347
C. A. C.-91	do	October 23	349
C. A. C.-93	do	October 20	346
C. A. C.-94	do	October 25	351
C. A. C.-95	November 8	October 20	346
C. A. C.-96	do	October 23	349
C. A. C.-98	November 7	October 20	347
C. A.-12797	November 12	November 3	356
Demerara-95	November 19	November 26	372
Demerara-1135	November 7	October 21	348
Formosa	November 6	October 22	350
Goru or New Guinea 24	November 7	October 28	355
Hambledon-5	November 6	October 20	348
Hambledon-426	November 7	November 2	360
Hambledon-426 Sport	do	October 25	352
Hawaii-16	November 6	November 2	361
Hawaii-20	November 7	October 27	354
Hawaii-27	November 6	October 23	351
Hawaii-69	November 7	October 21	348
Hawaii-109	November 5	October 23	352
Hawaii-227	November 6	October 21	349
Hawaii-309	November 7	October 20	347
Imperial Striped Cheribon	do	October 28	355
Inalmon or Dark Negros	Nobemver 8	October 22	348
Java-213	November 5	December 2	392
Java-247	do	October 23	352
Louisiana Purple	November 6	December 22	411
Louisiana Striped	do	October 22	350
Malabar	do	November 7	366
Malagache	November 14	October 23	343
Mindoro	November 6	October 21	349
Negros Purple	November 7	October 21	348
New Guinea 24-A	do	October 26	353
New Guinea 24-B	do	October 27	354
Rose Bamboo	do	October 24	351
Yellow Celedonia	November 6	November 7	366

Table III shows the observations on the age of flowering in 1924-1925 flowering season. Negros Striped and La Carlota Cane 24/1 were the earliest varieties to flower, the former in 336 days and the latter in 337 days. Luzon-2 flowered last, when it was 399 days old.

TABLE III.—*Relative date and age of flowering of different varieties of sugar cane (1924-1925)*

Variety name	Date planted 1924	Date of flowering 1925	Age
			Days
Alabang-1	October 31	October 6	341
Alabang-2	do	October 5	340
Alabang-3	do	October 29	364
Alabang-5	do	October 13	348
Badila	October 15	November 2	384
Big Tanna	do	November 4	386
Barbados	do	October 19	370
Barbados Striped	do	October 30	381
Cebu Purple	do	October 15	366
Chinois	October 16	November 9	390
C. A. C.-88	do	October 10	360
C. A. C.-89	do	October 13	363
C. A. C.-90	do	November 1	382
C. A. C.-91	do	October 15	365
C. A. C.-93	October 17	October 19	368
C. A. C.-94	do	October 10	359
C. A. C.-95	do	October 11	360
C. A. C.-96	do	October 20	369
C. A.-12797	do	September 24	343
Demerara-95	October 18	November 9	388
Demerara-1135	do	October 8	356
Formosa	do	October 13	361
Goru or New Guinea 24	do	October 17	365
Hawaii-16	do	October 30	378
Hawaii-20	do	October 15	363
Hawaii-27	October 24	October 16	358
Hawaii-69	do	October 10	352
Hawaii-109	do	October 16	358
La Carlota Cane-24-1	do	September 25	337
Hawaii-227	do	October 12	354
Hawaii-309	do	October 10	352
Hambledon-5	October 27	October 21	360
Habledon-426	do	October 21	360
Hambledon-426-Sport	do	October 15	354
Inalmon	do	October 9	348
Inalmon White	do	October 10	349
Java 247	do	October 15	354
Louisiana Striped	October 28	October 12	350
Luzon-1	do	October 13	351
Luzon-2	do	November 10	379
Luzon-3	do	.....	.....
Luzon-4	do	.....	.....
Mindoro	do	October 12	350
Malabar	do	October 17	355
Malagache	do	October 16	354
New Guinea 24-A	do	October 16	354
New Guinea-24-B	do	October 15	353
New Guinea-40	October 29	November 3	371
Negros Striped	do	September 29	336
Negros Purple	do	October 10	347
Queensland-426	do	October 13	350
Rose Bamboo	do	October 13	350
Yellow Caledonia	do	November 2	370
La Carlota Cane-24-2	October 30	October 16	352
La Carlota Cane-24-3	do	October 14	350
La Carlota Cane-24-4	October 31	October 15	350
La Carlota Cane-24-5	do	October 13	348
La Carlota Cane-24-6	do	October 15	350
La Carlota Cane-24-7	do	October 14	349
C. A. C.-98	November 15	October 9	329
Mauritius-1900	November 28	November 2	340

TABLE IV.—*Average age of flowering of different varieties of sugar cane*

Variety name	Age	Variety name	Age
	Days		Days
Alabang-1	341	Hawaii-69	350
Alabang-2	338	Hawaii-109	355
Alabang-3	350	Hawaii-227	352
Alabang-5	346	Hawaii-309	350
Badila	368	Imperial Striped Cheribon	355
Barbados	366	Inalmon	348
Barbados Striped	368	Inalmon White	349
Big Tanna	380	Java-213	392
Cebu Purple	358	Java-247	353
Cheribon	354	La Carlota Cane-24-1	337
Chinois	388	La Carlota Cane-24-2	352
C. A. C.-88	356	La Carlota Cane-24-3	350
C. A. C.-89	363	La Carlota Cane-24-4	350
C. A. C.-90	365	La Carlota Cane-24-5	348
C. A. C.-91	357	La Carlota Cane-24-6	350
C. A. C.-93	357	La Carlota Cane-24-7	340
C. A. C.-94	355	Louisiana Purple	411
C. A. C.-95	353	Louisiana Striped	350
C. A. C.-96	359	Luzon-1	351
C. A. C.-98	338	Luzon-2	379
C. A.-12797	350	Malabar	361
Demerara-95	384	Malagache	349
Demerara-1135	352	Mindoro	350
Formosa	356	Mauritius-1900	340
Goru or New Guinea 24	360	Negros Purple	348
Hambledon-5	354	Negros Striped	336
Hambledon-426	360	New Guinea 24-A	354
Hambledon-426-Sport	353	New Guinea 24-B	354
Hawaii-16	370	New Guinea 40	371
Hawaii-20	359	Queensland-426	350
Hawaii-27	355	Rose Bamboo	351
		Yellow Caledonia	368

As shown in Table IV above, Negros Striped, La Carlota Cane-24/1, Alabang-2 and C. A. C.-98 were the earliest varieties to flower, while Louisiana Purple was the latest. The range of the number of days from planting to flowering was 336 to 411 days.

(3) *Pollen supply.*—Fifty varieties of sugar cane were used in this experiment and examined for pollen supply with a hand lens. Very early in the morning the arrows were each placed in a bag and then brought to the laboratory. There each was removed from its bag and shaken into a glass jar. The bag was opened to collect any pollen grains that might have adhered to the sides.

Results.—Out of the fifty varieties examined the following 40 varieties were found to be well supplied with pollen, 6 were poorly supplied and 4 were not supplied with pollen at all.

WELL SUPPLIED WITH POLLENS

1. Alabang–2	21. Hawaii–227
2. Alabang–5	22. Hawaii–309
3. Barbados	23. Hambledon–5
4. C. A. C.–88	24. Hambledon–426
5. C. A. C.–89	25. Hambledon–426 Sport
6. C. A. C.–90	26. Inalmon
7. C. A. C.–93	27. Java–247
8. C. A. C.–94	28. Louisiana Striped
9. C. A. C.–95	29. Luzon–1
10. C. A. C.–96	30. L. C. C.–24/1 [a]
11. C. A. C.–98	31. L. C. C.–24/2 [a]
12. C. A.–12797	32. L. C. C.–24/3 [a]
13. Cebu Purple	33. L. C. C.–24/4 [a]
14. Demerara–1135	34. L. C. C.–24/5 [a]
15. Goru or New Guinea 24	35. Malagache
16. Hawaii–16	36. Mindoro
17. Hawaii–20	37. New Guinea 24–A
18. Hawaii–27	38. New Guinea 24–B
19. Hawaii–69	39. Queensland–426
20. Hawaii–109	40. Rose Bamboo

POORLY SUPPLIED WITH POLLENS

1. Badila	4. Luzon White
2. Formosa	5. Negros Purple
3. Louisiana Purple	6. C. A. C.–91

NOT SUPPLIED WITH POLLEN AT ALL

1. Big Tanna	3. Inalmon White
2. Chinois	4. Yellow Caledonia

(4) *Length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds or fruits.*—The length of time from shooting to pollination, from shooting to complete appearance of arrow and from shooting to ripening of seeds was determined from 50 varieties of the 1924–1925 crop of sugar cane under culture at the station. Three vigorous and healthy stalks or plants of each variety to represent that variety were used in this test. The stalks were numbered 1 to 3 and the date of appearance of the arrow, the date of pollination, the date of complete appearance of arrow and the date of repining of seeds were noted and recorded. The same stalks

[a] L. C. C.–24/1, L. C. C.–24/2, L. C. C.–24/3, and L. C. C.–24/4, and L. C. C.–24/5, were L. C. E. S. C. 1, L. C. E. S. C. 2, L. C. E. S. C. 4 and L. C. E. S. C. 6, respectively.

were used in determining the date of pollination, the date of complete appearance of arrow and the date of ripening of seeds.

Results.—Table V shows the length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds on the different stalks or plants in different sugar-cane varieties at the station. It was found that the length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds was very variable even with the plants in the variety, being from 2 to 18 days, 2 to 17 days and 11 to 31 days, respectively. Table VI shows that the length of time from shooting to pollination varied with different varieties, ranging from 4 to 14 days which were represented by La Carlota Cane–24/4 and C. A.–12797F2, the earliest and C. A. C.–93 the latest. The length of time from shooting to complete appearance of the arrow ranged from 4 to 15 days. La Carlota Cane–24/1 and La Carlota Cane–24/5 were the earliest. Badila and Goru or New Guinea 24 were the latest. The length of time from shooting to ripening of seeds varied with different varieties. The range was from 14 to 29 days. Hawaii–109 was the earliest and Yellow Caledonia was the latest to mature the seeds.

TABLE V.—*The length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds of the different plants in the different varieties.*

Variety name	Number of plant	Date of appearance of arrow 1925	Date ready for pollination 1925	Number of days	Date of complete appearance of arrow 1925	Number of days	Date ripened 1925	Number of days
Queensland–426	1	Oct. 23	Nov. 5	13	Nov. 6	14	Nov. 20	28
Do	2	Oct. 22	Nov. 2	11	Nov. 5	14	Nov. 18	27
Do	3	Oct. 23	...do....	10	Nov. 3	11	...do....	26
Negros Purple	1	...do....	Nov. 4	12	Nov. 6	14	Nov. 14	22
Do	2	Oct. 28	Nov. 6	9	Nov. 4	7	...do....	17
Java–247	1	Oct. 27	Nov. 2	6	Nov. 2	6	Nov. 19	23
Do	2	Oct. 23	Oct. 29	6	Oct. 29	6	Nov. 18	26
Louisiana Striped	1	...do....	Oct. 28	5	...do....	6	...do....	26
Do	2	...do....	Oct. 29	6	Oct. 30	7	...do....	26
Do	3	Oct. 24	...do....	5	Nov. 29	5	...do....	25
Luzon–1	1	Oct. 28	Nov. 4	7	Nov. 6	9	Nov. 14	17
Do	2	Oct. 23	Nov. 7	15	Nov. 9	17	...do....	22
Do	3	Oct. 21	Nov. 6	16	Nov. 7	17	...do....	24
Mindoro	1	Nov. 3	Nov. 7	4	Nov. 10	7	Nov. 20	17
Do	2	Oct. 29	Nov. 5	7	Nov. 7	9	Nov. 18	20
Do	3	Oct. 28	Nov. 6	9	...do....	10	Nov. 20	23
Malagache	1	Oct. 22	Nov. 2	11	Oct. 29	7	Nov. 16	25
Do	2	...do....	Nov. 2	11	Oct. 30	8	Nov. 18	27
Do	3	Oct. 23	Nov. 1	9	Oct. 29	6	...do....	26
New Guinea 24–A	1	Nov. 2	Nov. 7	5	Nov. 10	8	Nov. 27	25
Do	2	Nov. 3	...do....	4	...do....	7	...do....	24
Do	3	Nov. 2	...do....	5	Nov. 9	7	...do....	25
New Guinea 24–B	1	Oct. 23	Nov. 5	13	Nov. 5	13	Nov. 18	26
Do	2	Oct. 22	...do....	14	...do....	14	...do....	27
Do	3	Oct. 23	...do....	13	...do....	13	...do....	26
Inalmon White	1	...do....	Oct. 30	7	Oct. 29	6	...do....	26
Do	2	...do....	...do....	7	...do....	6	Nov. 10	18
Do	3	...do....	...do....	7	...do....	6	...do....	18

TABLE V.—*The length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds of the different plants in the different varieties*—Continued.

Variety name	Number of plant	Date of appearance of arrow 1925	Date ready for pollination 1925	Number of days	Date of complete appearance of arrow 1925	Number of days	Date ripened 1925	Number of days
Inalmon	1	Oct. 22	Oct. 30	8	Oct. 29	7	Nov. 10	19
Do	2	...do...	Oct. 29	7	Oct. 28	6	...do...	19
Do	3	Oct. 24	Nov. 2	9	Nov. 2	9	...do...	17
Hambledon-426 Sport	1	Oct. 23	Oct. 1	9	Oct. 30	7	Nov. 14	22
Do	2	Oct. 22	Oct. 29	7	Oct. 31	9	...do...	23
Do	3	...do...	Nov. 4	13	Oct. 29	7	...do...	23
Hambledon-426	1	Oct. 23	Oct. 30	7	...do...	6	Nov. 18	26
Do	2	Oct. 24	...do...	6	...do...	5	...do...	25
Do	3	Oct. 23	Oct. 29	6	...do...	6	Nov. 20	28
Hambledon-5	1	Oct. 22	Nov. 1	10	Oct. 30	8	Nov. 10	19
Do	2	Oct. 21	Oct. 30	9	Oct. 29	8	...do...	20
Do	3	Oct. 23	Oct. 29	6	Oct. 28	5	Nov. 14	22
Hawaii-309	1	Oct. 22	...do...	7	Nov. 6	14	...do...	23
Do	2	...do...	...do...	7	...do...	14	Nov. 10	19
Do	3	Oct. 21	...do...	8	Oct. 30	9	...do...	20
Hawaii-227	1	Oct. 23	Oct. 30	7	...do...	7	Nov. 16	24
Do	2	...do...	...do...	7	...do...	7	Nov. 14	22
Do	3	Oct. 21	...do...	9	...do...	9	Nov. 16	26
L. C. C.-24/1	1	Oct. 25	Oct. 29	4	Oct. 28	3	Nov. 10	16
Do	2	Oct. 30	Nov. 7	8	Nov. 2	3	Nov. 20	21
Do	3	...do...	Nov. 6	7	Nov. 5	6	Nov. 10	11
Hawaii-109	1	Oct. 28	Nov. 1	4	Nov. 1	4	...do...	13
Do	2	Oct. 29	Nov. 2	4	Nov. 3	5	...do...	12
Do	3	Oct. 23	Oct. 29	6	Oct. 29	6	...do...	18
Hawaii-69	1	...do...	Oct. 30	7	...do...	6	Nov. 14	22
Do	2	Oct. 24	Nov. 7	14	Nov. 5	12	Nov. 18	25
Do	3	...do...	Nov. 5	12	Nov. 7	14	Nov. 10	17
Hawaii-27	1	Oct. 22	Oct. 30	8	Oct. 30	8	...do...	19
Do	2	Oct. 23	...do...	7	...do...	7	...do...	18
Do	3	...do...	...do...	7	Oct. 29	6	Nov. 14	22
Hawaii-20	1	...do...	...do...	7	Oct. 31	8	...do...	22
Do	2	Oct. 22	...do...	8	Oct. 30	8	Nov. 16	25
Do	3	Oct. 21	...do...	9	Oct. 29	8	Nov. 10	20
Hawaii-16	1	Nov. 5	Nov. 16	11	Nov. 18	13	Nov. 27	22
Do	2	Nov. 2	Nov. 14	12	Nov. 13	11	Nov. 23	21
Do	3	Oct. 30	Nov. 10	11	Nov. 14	15	...do...	24
Goru or N. G.-24	1	Oct. 23	Nov. 6	14	Nov. 7	15	Nov. 18	26
Do	2	...do...	Nov. 5	13	...do...	15	...do...	26
Do	3	...do...	...do...	13	...do...	15	...do...	26
Formosa	1	Nov. 2	Nov. 7	5	Nov. 10	8	Nov. 18	16
Do	2	Oct. 24	Oct. 31	7	Oct. 31	7	Nov. 19	26
Demerara-1135	1	Nov. 3	Nov. 9	6	Nov. 10	7	Nov. 21	18
Do	2	Oct. 23	Oct. 30	7	Oct. 29	6	Nov. 16	24
Do	3	Oct. 22	Nov. 1	10	Oct. 30	8	...do...	25
Alabang-2	1	Nov. 1	Nov. 7	6	Nov. 9	8	....	.....
Do	2	Oct. 28	Nov. 6	9	Nov. 7	10	Nov. 18	21
Do	3	Nov. 1	Nov. 7	6	Nov. 10	9	Nov. 16	15
Alabang-3	1	...do...	...do...	6	...do...	9	Nov. 18	17
Do	2	...do...	...do...	6	...do...	9	Nov. 21	20
Do	3	Oct. 30	...do...	8	...do...	11	Nov. 18	19
Alabang-5	1	Nov. 2	...do...	5	...do...	8	Nov. 21	19
Do	2	Nov. 1	...do...	6	...do...	9	Nov. 21	20
C. A. C.-98	1	Oct. 22	Oct. 29	7	Oct. 28	6	Nov. 16	25
Do	2	...do...	Oct. 29	7	Oct. 29	7	Nov. 10	19
Do	3	Oct. 23	Nov. 1	9	Oct. 30	7	Nov. 14	22
Alabang-1	1	Oct. 24	Nov. 6	13	Nov. 7	14	Nov. 18	25
Do	2	Oct. 20	Oct. 30	10	Oct. 29	9	Nov. 10	21
Do	3	Nov. 2	Nov. 10	8	Nov. 14	12	Nov. 18	16
L. C. C.-24/7	1	Oct. 21	Oct. 30	9	Oct. 29	8	...do...	28
Do	2	...do...	Oct. 29	8	Oct. 27	6	...do...	28
Do	3	...do...	...do...	8	...do...	6	Nov. 10	20
L. C. C.-24/6	1	Nov. 1	Nov. 9	8	Nov. 10	9	Nov. 16	15
Do	2	Oct. 20	Oct. 31	11	Oct. 30	10	Nov. 10	21
Do	3	Oct. 24	Nov. 3	10	Nov. 5	12	...do...	17
L. C. C.-24/5	1	Oct. 22	Oct. 29	7	Oct. 27	5	...do...	19
Do	2	Oct. 21	Oct. 28	7	...do...	6	...do...	20
Do	3	...do...	Oct. 29	8	Oct. 23	2	...do...	20
L. C. C.-24/4	1	Nov. 1	Nov. 3	2	Nov. 7	6	Nov. 18	17
Do	2	Nov. 1	Nov. 6	5	...do...	6	...do...	17
Do	3	Nov. 2	Nov. 7	5	...do...	5	Nov. 21	19

TABLE V.—*The length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds of the different plants in the different varieties*—Continued.

Variety name	Number of plant	Date of appearance of arrow 1925	Date ready for pollination 1925	Number of days	Date of complete appearance of arrow 1925	Number of days	Date ripened 1925	Number of days
L. C. C.-24/3	1	Oct. 23	Oct. 29	6	Oct. 29	6	Nov. 18	26
Do	2	...do....	Oct. 28	5	Oct. 27	4	...do....	26
Do	3	...do....	...do....	5	Oct. 28	5	Nov. 16	24
L. C. C.-24/2	1	Oct. 29	Nov. 6	8	Nov. 7	10	Nov. 21	23
Do	2	...do....	Nov. 5	7	Nov. 6	8	...do....	23
Do	3	Nov. 2	Nov. 7	5	Nov. 9	7	Nov. 23	21
Yellow Caledonia	1	...do....	Nov. 13	11	....	......	Dec. 2	30
Do	2	Nov. 4	Nov. 14	10	....	......	...do....	28
Rose Bamboo	1	Oct. 23	Nov. 3	11	Nov. 4	12	Nov. 18	26
Do	2	Oct. 29	Nov. 4	6	Nov. 6	8	Nov. 19	21
Do	3	Oct. 27	...do....	8	Nov. 4	8	Nov. 18	22
Badila	1	Nov. 3	Nov. 14	11	Nov. 18	15	Dec. 1	28
Do	2	...do....	...do....	11	Nov. 16	13	...do....	28
Do	3	Nov. 1	Nov. 13	12	Nov. 18	17	Nov. 26	25
Barbados	1	Oct. 23	Nov. 10	18	Nov. 9	17	Nov. 23	31
Do	2	Oct. 30	Nov. 9	10	Nov. 13	14	Nov. 27	28
Do	3	Nov. 2	...do....	7	Nov. 14	12	Nov. 26	24
Barbados Striped	1	...do....	...do....	7	...do....	12	...do....	24
Do	2	...do....	Nov. 10	8	...do....	12	...do....	24
Do	3	...do....	...do....	8	Nov. 16	14	...do....	24
Cebu Purple	1	Oct. 23	Oct. 30	7	Oct. 30	7	Nov. 18	26
Do	2	Oct. 22	Nov. 1	10	Nov. 1	10	...do....	27
Do	3	...do....	Oct. 30	8	Oct. 30	8	...do....	27
C. A. C.-88	1	Oct. 21	...do....	9	Nov. 2	12	Nov. 14	24
Do	2	...do....	...do....	9	...do....	12	...do....	24
Do	3	Oct. 20	Nov. 2	13	Nov. 1	12	...do....	25
C. A. C.-89	1	Oct. 23	Oct. 30	7	Oct. 29	6	...do....	22
Do	2	Oct. 21	Oct. 29	8	...do....	8	...do....	24
C. A. C.-90	1	Nov. 3	Nov. 9	6	Nov. 11	8	Nov. 23	20
Do	2	Nov. 2	...do....	7	Nov. 10	8	Nov. 21	19
Do	3	Nov. 1	Nov. 3	2	Nov. 3	2	Nov. 19	18
C. A. C.-91	1	Oct. 23	Oct. 31	8	Oct. 31	8	Nov. 18	26
Do	2	...do....	Oct. 30	7	Oct. 26	3	Nov. 19	27
Do	3	...do....	Nov. 1	9	Oct. 31	8	Nov. 16	24
C. A. C.-93	1	...do....	Nov. 9	17	Nov. 9	17	...do....	24
Do	2	...do....	Nov. 5	13	...do....	11	...do....	24
Do	3	Oct. 24	...do....	12	...do....	10	...do....	23
C. A. C.-95	1	Oct. 23	Oct. 30	7	Oct. 30	7	Nov. 14	22
Do	2	Oct. 21	...do....	9	...do....	9	...do....	24
Do	3	Oct. 24	...do....	6	...do....	6	Nov. 16	23
C. A. C.-96	1	...do....	Nov. 1	8	Oct. 27	3	Nov. 18	25
Do	2	Oct. 23	...do....	9	Oct. 26	3	...do....	26
Do	3	...do....	Oct. 30	7	Oct. 31	8	...do....	26
C. A.-12797	1	Nov. 5	Nov. 9	4	Nov. 10	5	Nov. 27	22
Do	2	Nov. 4	Nov. 8	4	Nov. 9	5	Nov. 23	19
Do	3	Nov. 5	Nov. 9	4	Nov. 10	5	Nov. 27	22

TABLE VI.—*Length of time from shooting to pollination to complete appearance of arrow and to ripening of seeds of the different varieties of sugar cane.*

Variety name	Number of days from shooting to—		
	Pollination	Complete appearance	Ripening of seeds
	Days	*Days*	*Days*
Alabang-1	10	12	21
Alabang-2	7	9	18
Alabang-3	7	10	19
Alabang-5	6	9	20
Badila	11	15	27
Barbados	12	14	28
Barbados Striped	8	13	24
Cebu Purple	8	8	27
C. A. C.-88	10	12	24
C. A. C.-89	8	7	23
C. A. C.-90	5	6	19
C. A. C.-91	8	10	26
C. A. C.-93	14	13	24
C. A. C.-95	7	7	23
C. A. C.-96	8	5	26
C. A. C.-98	8	7	22
C. A.-12797	4	5	21
Demerara-1135	8	7	22
Formosa	6	8	21
Goru or N. G. 24	13	15	26
Hambledon 5	8	7	20
Hambledon 426	6	6	26
Hambledon 426 Sport	10	8	23
Hawaii-16	11	13	22
Hawaii-20	8	8	22
Hawaii-27	7	7	20
Hawaii-69	11	11	21
Hawaii-109	5	5	14
Hawaii-227	8	8	24
Hawaii-309	7	12	21
Inalmon	8	7	18
Inalmon White	7	6	21
Java 247	6	6	25
La Carlota Cane 24-1	6	4	16
La Carlota Cane 24-2	7	8	22
La Carlota Cane 24-3	5	5	25
La Carlota Cane 24-4	4	6	18
La Carlota Cane 24-5	7	4	20
La Carlota Cane 24-6	10	10	18
La Carlota Cane 24-7	8	7	25
Louisiana Striped	5	6	26
Luzon 1	13	14	21
Malagache	10	7	26
Mindoro	7	9	20
Negros Purple	11	11	20
New Guinea 24-A	5	7	25
New Guinea 24-B	13	13	26
Queensland 426	11	13	27
Rose Bamboo	8	9	23
Yellow Caledonia	11	....	29

(5) *Vitality and viability of sugar-cane seeds.*—Numerous sugar-cane varieties were tested for their vitality. Eight varieties were found to have good vital seeds: were Inalmon White, Louisiana Striped, New Guinea 24–A, Hawaii–109 and Badila. Three varieties were found to have very poor vital seeds: Big Tanna, Barbados and Yellow Caledonia. The viability of sugar-cane seeds was also tested. The seeds of ten arrows each of Negros Purple and Hawaii–109 were collected and mixed in one envelope. These were divided afterwards into five equal lots.

Each part consisted of 100 seeds. The seeds were planted on sterilized soil in seed flats. The following table shows the viability of Negros Purple and Hawaii–109 seeds:

TABLE VII.—*Viability of Negros Purple and Hawaii–109 seeds*

Variety name	Date harvested 1925	First planting			Second planting		
		Date 1925	Number of seeds germinated	Per cent germinated	Date 1925	Number of seed germinated	Per cent germinated
Negros Purple	Nov. 10	Nov. 17	16	16	Dec. 2	10	10
Hawaii	do	do	51	51	do	100	100

Variety name	Third planting			Fourth planting		
	Date 1925	Number of seeds germinated	Per cent germinated	Date 1926	Number of seeds germinated	Per cent germinated
Negros Purple	Dec. 17	15	15	Jan. 6	0	0
Hawaii	do	3	3	do	2	2

As the results show the viability of Negros Purple and Hawaii-109 seeds was only 37 days and 58 days from harvesting, respectively.

DISCUSSION OF RESULTS

Relative date and age of flowering.—The flowering seasons of sugar-cane varieties at La Carlota Sugar-cane Experiment Station, are September, October, November, and December. The length of the flowering seasons ranges from 57 to 63 days.

The flowering ages of sugar-cane varieties were found to be variable, ranging from 366 to 411 days. Negros Striped, La Carlota Cane–24/1, Alabang–2, and C. A. C.–98 were the earliest varieties to flower, while Louisiana Purple was the latest.

Pollen supply.—Most varieties examined were found to be well supplied with pollen.

Length of time from shooting to pollination.—In a variety test the length of time from shooting to pollination was variable. The range was from 2 to 18 days within the variety. While between the different varieties the range was from 4 to 14 days.

Length of time to complete appearance of arrow.—As shown in Table V the length of time from shooting to complete appearance of arrow was variable even within the variety. The ranges of variability were from 2 to 17 days within the variety and from 4 to 15 days within different varieties.

Length of time from shooting to ripening of seeds.—The length of time from shooting to ripening of seeds as shown in

Table V was also variable even within the variety. The range of variability within the variety was from 11 to 31 days and within different varieties was from 14 to 29 days.

Vitality and viability of sugar-cane seeds.—The vitality and viability of sugar-cane seeds were variable, depending on the variety. Six varieties—Inalmon, Inalmon White, Louisiana Striped, New Guinea 24–A, Hawaii–109, and Badila—were found to produce extremely vital seeds, while Big Tanna, Barbados and Yellow Caledonia were found to have seeds of very poor vitality. Negros Purple and Hawaii–109 seeds could be stored up to 37 days and 58 days, respectively, before they became useless for planting purposes.

SUMMARY OF CONCLUSIONS

1. There is no fixed time for sugar-cane flowers to bloom and for the opening of anthers.

2. The flowering season of the sugar cane varieties at La Carlota Sugar Cane Experiment Station covers the months of September, October, November, and December. In 1924 the flowering season began on the 20th of October and ended on the 22nd of December, covering a period of 63 days, while in 1925 the flowering season began September 24 and ended November 10, covering a period of 57 days.

3. The ages of flowering of sugar-cane varieties were found to be variable, ranging from 366 to 411 days. Negros Striped, La Carlota Cane–24/1, Alabang–2, and C. A. C.–98 were the earliest varieties to flower, while Louisiana Purple was the latest.

4. Most varieties examined were well supplied with pollen, but the amount was found to be very variable.

5. The length of time from shooting to complete appearance of arrow and to ripening of seeds was variable, even with the plants of the same varieties. The length of time from shooting to pollination, to complete appearance of arrow and to ripening of seeds was from 4 to 14 days, from 4 to 15 days, and from 14 to 29 days, respectively.

6. The vitality and viability of sugar-cane seeds were found to be variable. It took the sugar-cane seeds to remain viable in 37 days after harvest.

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2. PAGLINAWAN, SERGIO B. The Philippine Agriculturist, Vol. XIV, No. 2, July, 1925.

NOTE ON THE OCCURRENCE OF *SARCOCYSTIS* IN THE PHILIPPINE CARABAO (*BUBALUS BUBALIS* Linn.)

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Two instances of infection of the carabao, *Bubalus bubalis* Linnaeus, with the Sporozoan muscle parasite *Sarcocystis*, have been detected in Luzon. The first instance came to the attention of Dr. W. H. Boynton, formerly pathologist to the Bureau of Agriculture, in 1916. The second case was detected by the author in material submitted for examination by the district health officer of Pasig, Rizal, in November, 1926. The animal that furnished the material for Doctor Boynton's case was found in San Fernando, Pampanga. The second animal was found in Pasig. No similar infection having been recorded in the Philippine Islands up to that time, Doctor Boynton forwarded the material to the late Dr. Brayton H. Ransom, of the Zoölogical Division of the United States Bureau of Agriculture for identification. Doctor Ransom pronounced it *Sarcocystis blanchardi.*

The material upon which this note is based was forwarded to the Bureau of Science through Dr. Gabriel Intengan, chief of the Division of Provincial Sanitation, Philippine Health Service. It consisted of several pieces of striped muscle tissue about one by two centimeters in length and breadth, and about one centimeter in thickness. These were bottled in strong alcohol and were in a good state of preservation when received in the Bureau of Science. Numerous spore cases (Miescher's tubes) could be seen in the muscle tissue. These, for the most part, were spindle-shaped, although some were enlarged and flattened at one pole. They ranged in length from one-half to one centimeter and were about two to four millimeters in diameter at their widest part. They were approximately circular in cross-section.

The health officer who found the parasites was inclined to suspect that they were cysticerci, and submitted the tissue to his home office with that tentative diagnosis. Information as to the site in the animal's body from which the tissue was removed and as to the probable cause of the animal's death could not be obtained by the writer.

The material was referred to the author for study. Inspection of the outer surface of several of the whitish bodies failed to demonstrate any structure that in any way resembled a scolex, which disposed of the supposition that they might be developmental stages of some cestode. The blocks of tissue were removed from the alcohol in which they had been delivered and treated for a short time with 95 per cent ethyl alcohol to which five per cent of glacial acetic acid had been added. This was to counteract, if possible, the shrinkage produced by the pure alcohol. However, when examined, the material showed unmistakable evidence of shrinkage and although the general preservation was good the method of fixation precluded accurate cytological study or measurement.

One of the little white spore cases was cut out of the muscle tissue and the contents smeared on a slide which had been coated at the center with a thin layer of Mayer's albumin. The preparation was immediately immersed in 95 per cent alcohol, carried down through the graded alcohols, stained with Delefield's haematoxylin and mounted in balsam. The preparation showed innumerable falciform, nucleated bodies corresponding in structure to those described by various authors as Rainey's corpuscles. They measured *ca.* 10 μ to 12 μ in length. The identification was completed by making paraffine sections through blocks of the muscle tissue containing Miescher's tubes. High and low power photomicrographs of these sections, after they were stained and mounted, are shown in the plate accompanying this article. The septate structure of the spore-case is clearly shown in Fig. 1, which dipicts a portion of a spore case surrounded by muscle fibres. Individual spores or Rainey's corpuscles are shown in the high-power view in Fig. 2.

In his letter to the Director of Agriculture in which he commented on the material sent to him by Doctor Boynton, Doctor Ransom said:

> The parasite is a sarcosporidian, *Sarcocystis blanchardi,* which appears to be rather widely distributed amongst the domesticated buffaloes of both the mainland and islands of Asia. Whether it does any harm to the animals it parasitizes is a matter which has never been determinated.

I have no information regarding the character of the material sent to Washington which formed the basis for the specific designation given it by Doctor Ransom. I do not, however, consider that the quantity or condition of the material from the second case justify me in arbitrarily designating the parasite *Sarcocystis blanchardi,* notwithstanding later investigation may prove

that to be the species infesting Philippine carabaos. It seems better for the present simply to designate it *Sarcocystis sp.*, thus avoiding troublesome questions of synonomy later on.

In connection with this it is well to remember that Sarcosporidia of buffaloes have been given at least four different specific names. Railliet, in 1897, designated his species *Sarcocystis fusiformis;* Doflein, in 1901, his as *S. blanchardi;* von Listow, in 1903, his as *S. siamensis,* while Willey, Chalmers and Philip bestowed the trinomial *S. tenella bubali,* on the parasite discussed by them in 1904.

The systematic position of the so-called Sarcosporidia, aside from the fact that they give evidence of being Sporozoa, is not by any means clear, and it will not be until the life cycle has been fully and accurately worked out. Moreover, the validity of most species, a considerable number of which are recorded in the literature, is open to considerable doubt. Feeding experiment conducted by several investigators have indicated very strongly that most if not all Sarcosporidia are not specific to any particular host.

Sarcocystis is found most frequently in striated muscles of Mammalia, but some observers have reported it as occasionally occurring in smooth muscle. It has been found, in some instances, in birds and reptiles. It is an exceedingly common parasite in sheep, cattle, and horses, as well as mice and some other Rodentia. It has been reported in man in eight apparently authenticated instances, the most recent report being that of Vasudevañ (1927) who found it in the chest muscle of a subject in India.

While the detection of two instances of infection with *Sarcocystis* in the Philippine Islands within a period of ten years does not suggest cause for alarm, yet the question of pathogenicity cannot be wholly without interest to stock-raisers and farmers.

McGowan (1923) has ventured the view that a disease of sheep known as "scrapie" is not unlikely caused by *Sarcocystis.* Green (1922) has described extensive degeneration of the muscles in pigs infected with *Sarcocystis miescheriana.* Animals heavily infected, experimentally, frequently die, death being attributed to the effects of the massive infections. The question of pathogenicity has been discussed at some length by Watson (1909) to whose paper the reader is referred for details. He regards *Sarcocystis* as a dangerous parasite under certain conditions.

On the other hand, it is well known that involvement of muscle tissue with *Sarcocystis* may become very extensive in instances and yet give rise to no recognizable symptoms in the host. This leads to the conclusion that further evidence is necessary before Sarcosporidiosis can take first rank as a problem in veterinary medicine.

It also has long been known that a definitely toxic substance could be extracted from *Sarcocystis*. To this Laveran and Mesnil (1899) gave the name sarcocystine. Teichmann and Braun (1911) succeeded in immunizing rabbits against the toxin of *Sarcocystis*. Just what part, if any, this toxin plays in the clinical reaction of animals to infection with *Sarcocystis* does not appear to be very clear on inspection of the literature.

Another point of local interest concerns the method by which cattle may become infected with *Sarcocystis*. It has been experimentally shown that Carnivora such as rats and mice, may be infected by feeding them raw infected flesh. With Herbivora, this method of transmission would, of course, seem not to apply and yet Sarcosporidiosis is exceedingly common among cattle, sheep, and horses. Sergent (1921) and Watson (1909) both have reported finding bodies believed by them to be spores of *Sarcocystis* in blood films made from Herbivora. Such observations are attended by great difficulties in interpretation, but they inevitably raise the question of insect transmission. However, it would appear to the writer that the possibility of the contamination of fodder by the fæces of infected animals would be quite as tenable a theory. It would seem quite possible in view of the apparent nonspecificity of this parasite, that cattle might easily acquire infection from the contamination of their food by the decomposing bodies of smaller mammals, birds or reptiles, or even by direct fæcal contamination from the same source.

Finally, a point of practical interest arises from the superficial resemblance the Miescher's corpuscles bear to cysticerci or even encysted Trichinellæ. This presents a problem to the meat inspector that is not devoid of troublesome features. So long as *Sarcocystis* confines itself to the carabao there would appear to be little cause for fear that it will become widespread among human beings here. Infecting swine and the higher grades of cattle designed for food, it might present dangers of the same grade as those offered by *Tænia* (Cysticercus) and *Trichinella*. Records of human infestation with *Sarcocystis* do not justify fear of this, but it is quite conceivable that heavy

involvement of the heart muscle, diaphragm or larynx might be attended by grave consequences to the person affected.

In the present state of our knowledge of the activities of this parasite the danger would appear to be far greater to livestock than to human beings. However, it seems to the writer to be proper to formally record the presence of this parasite in the Philippine Islands, and that is the main purpose of this note. The cytological condition of the material and lack of accompanying data on the case have precluded any attempt to add to our knowledge of the parasite itself.

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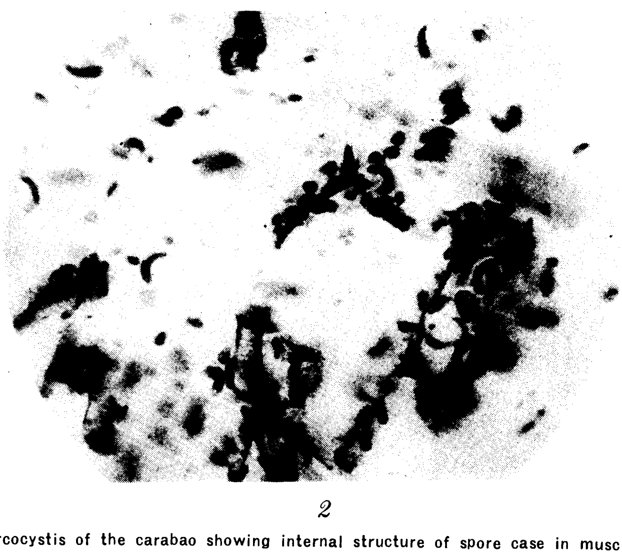


2

Sarcocystis of the carabao showing internal structure of spore case in muscle

NOTES ON THE MANGO TWIG BORER

(*Euclea capito* Pasc.)

By F. Q. OTANES
Entomologist, in charge of Entomology Section

and

A. G. TOQUERO Agricultural Assistant

This insect, a long-horned beetle (family Cerambycidae, subfamily Lamiinae order Coleoptera) is a common pest of the mango, *Mangifera indica.* It also attacks the following plants: avocado (*Persea americana*), *Acalypha tricolor,* papua (*Panax fruticosum*), *Citrus,* tiesa or canistel (*Lucuma nervosa*) bauno (*Mangifera caesia*), camphor (*Cinnamomum camphora*) and kapok (*Ceiba pentandra*). The mango, however, seems to be the favorite host of the insect, as may be judged from the damage it does to the plant. It is known to be injurious also to *Terminalia catappa* and *Barringtonia speciosa,* which are commonly grown as shade trees.

CHARACTER OF INJURY

The bettle girdles the young twigs of the host plants. The girdling has apparently two purposes; namely, to feed and to make a place to lay eggs in. Only one egg, so far as observed, is laid in each twig. The larva or grub upon hatching tunnels the twig with its strong jaws or mandibles, feeding as it goes. The twig eventually dies and the presence of the pest can thus be easily detected. When a mango tree is heavily infested these dead twigs give the tree the appearance of having been scorched by flames.

LIFE HISTORY AND DESCRIPTION

The egg.—The egg is ellipsoidal (cucumber-shaped) white and is 3.8 to 4.2 millimeters long and 0.9 to 1.1 millimeters wide It hatches in 4 to 7 days.

The larvae or grubs.—The grub, which is apodous or legless, is 3 to 3.5 millimeters long and 0.9 to 1.1 millimeters in diameter when newly hatched.

The full grown larva is 23 to 25 millimeters long and 4.3 to 6 millimeters in diameter. It is creamy white and somewhat

cylindrical. Its head is dark. According to our records, the larval stage is from 4 months and 6 days (126 days) to 7 months and 12 days (222 days).

The pupa.—The pupa is pale brown and is 18 to 22 millimeters long and 6 millimeters diameter. Pupation takes place in the tunnel inside the twig made by the larva itself. The pupal period is from 12 to 20 days.

The adult.—The adult is a brown clay bettle 18 to 21 millimeters long and 5.5 to 7.2 millimeters wide. The elytra or outer wings each have a prominent white spot. The lower surface of the body is brown clay. The mandibles or jaws and eyes are black. Generally the male is smaller than the female and is from 16 to 18 millimeters long and about 5 millimeters across at its greatest diameter. The female is 21 to 21.5 millimeters long and 7 to 7.2 millimeters in diameter.

CONTROL MEASURES

The insect is not difficult to control. The following measures will suffice to keep it in check:

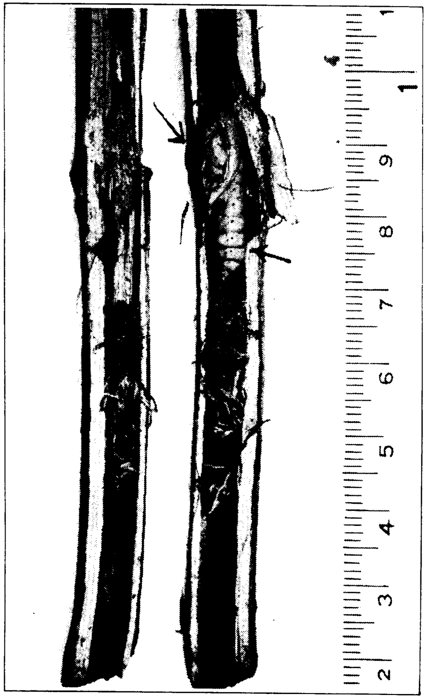
1. Cutting off the badly infested twigs as early as possible. These should be piled up on the ground for at least one month to allow the tiny wasp or hymenopterous parasites of the larvae to emerge. The twigs may later be burned, if desired. If the cutting is done early, there is no danger of any adult beetles developing from these.

2. The adults are not abundant but one female is capable of infesting about thirty or more twigs before it dies. They seldom fly and are easily seen on the twigs of the host plants. They should be collected and killed. In big groves the expenditure of a few pesos for laborers or boys will be sufficient to prevent damage by the pest. In Manila and vicinity we have found the beetles common from June to September, inclusive. They usually begin laying eggs in June, so that is the time to begin collecting the beetles.

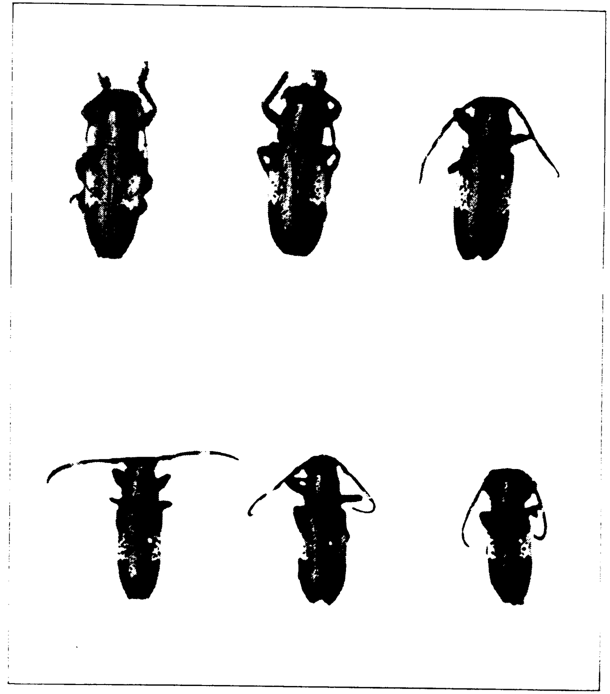
3. Smudging the trees will tend to drive away not only the beetles but other insects as well, such as the mango hoppers—*Idiocerus niveosparsus* and *Idiocerus clypealis*—which are the most serious pests of mango.

4. Insectivorous birds—such as woodpeckers—should not be killed. On the other hand every effort should be exerted to encourage their presence around the trees.

PLATE XXIII



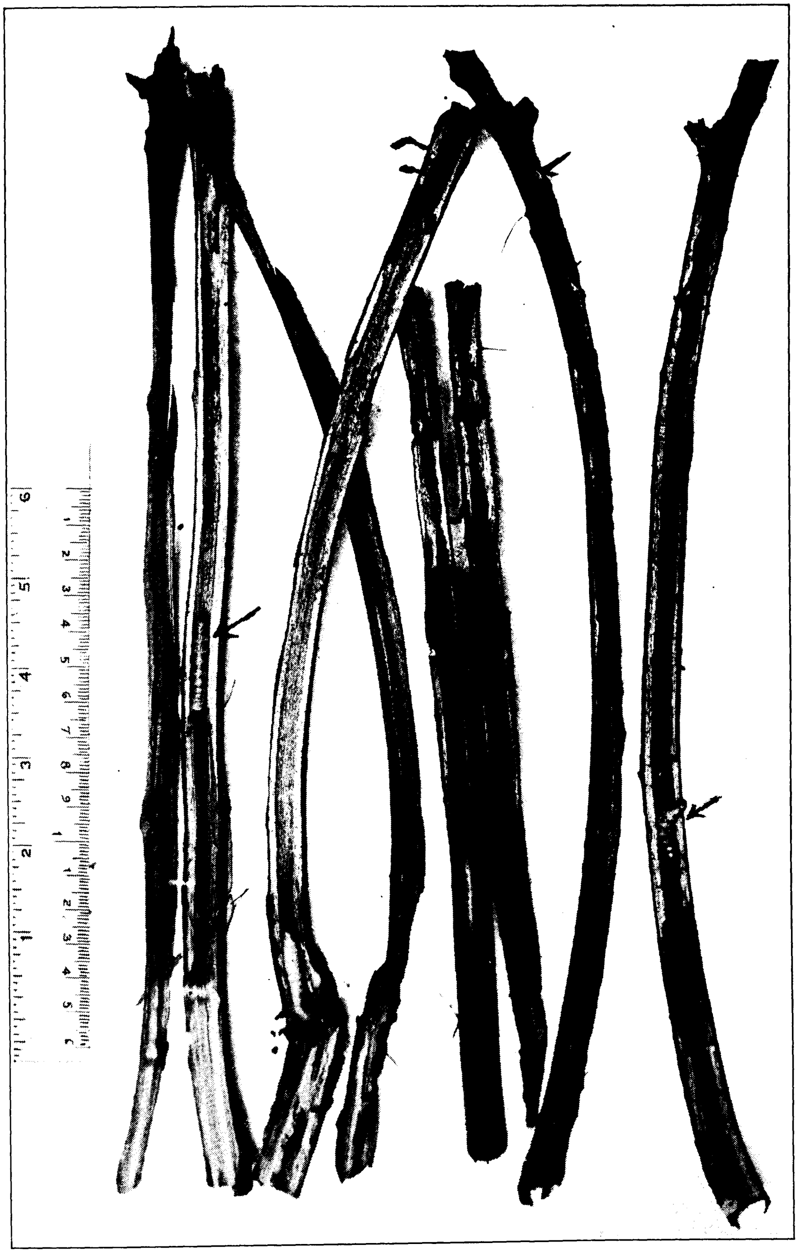
(*a*) Is a mango twig split to show pupa, as indicated by the arrow



(*b*) Shows the adult beetles of both sexes, the females being bigger.

A portion of a mango tree showing dead twigs, indicated by arrows, as a result of the work of the larvae of the mango twig borer—*Euclea capito*

A mango tree which is badly infested by the mango twig borer—*Euclea capito.* Note dried twigs indicated by arrows



Twigs of mango cut open to show the larvae of the mango twig borer, *Euclea capito*. Note the larvae, indicated by the arrows, and their tunnels

NOTES ON THE "DIAMOND BACK-MOTH"

Putella maculipennis Curtis

By F. Q. OTANES
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and

P. SISON
Plant Inspector

This insect, a small moth of the family *Yponomeutidae* (Curtis), Order Lepidoptera, is a destructive enemy of cabbage and other cruciferous vegetables such as radishes, pechay, etc. It is a cosmopolitan insect being known to occur wherever cabbages are grown. In the United States it is considered a pest of more or less importance, and is commonly known there as the "diamond back-moth," a name which is derived from the characteristic diamond-shaped markings on its wings when they are folded, that is when the insect is at rest. In the Philippines it has been found especially destructive at higher altitudes, such as in Silang, Cavite, and in Baguio, Benguet, where cabbages are raised quite extensively.

NATURE AND EXTENT OF DAMAGE

The moth lays its eggs usually on the lower surface of the cabbage leaves and the larvae or caterpillars upon hatching feed on them and riddle them with holes.

The plants may be so damaged that they will be stunted and will produce no heads. The caterpillars are capable of destroying whole patches or fields of cabbage and other related plants. The work of these caterpillars resembles that done by another moth, *Crocidolomia binotalis*,[1] which is also destructive to cabbages and is the more common and more destructive to cabbages and other cruciferous plants here. The caterpillars of both species may be found together infesting cabbage and other host plants.

On radishes and pechay the caterpillars of the diamond bock-moth even destroy the flowers and young pods and feed on the skin of the stem.

[1] See Bureau of Agriculture, Circular No. 175.

Missing Page

NATURAL ENEMIES

In the United States, in Colorado, H. O. Marsh [1] reared an inchneumonid parasite, *Angitia maculipennis*. An inchneumonid parasite has also been reared at Singalong from larvae and pupae of *Plutella* collected from Baguio, Benguet, by Mr. A. G. Toquero. Unfortunately the descriptions of *Angitia* were not available, but careful comparison of our specimens with Marsh's excellent drawing seems to show the species here to be identical. Specimens will be sent, however, to specialists for verification. Marsh also reports that *Angitia plutellae* is attacked by a secondary parasite, *Spilochalcis delira* Cress. We have also reared one specimen which, by comparing it with Marsh's drawing, we suspect to be of the same genus, if not identical species.

CONTROL MEASURES

1. *Spraying with soap solution.*—A solution of one-fourth kilo of soft yellow laundry soap (Chinese soap is good) dissolved in about 20 liters or about one kerosene canful of water has been found to kill the caterpillars or larvae. The spraying should be done early in the morning or late in the afternoon, and should be directed to the lower surfaces of the leaves where these caterpillars generally stay or hide. The spraying should be repeated whenever necessary.

2. *Spraying with lead arsenate.*—Spraying with lead arsenate at the rate of 1.5 to 4 grams per liter of water, (approximately 30 to 80 grams or 6 to 16 spoonfuls; levelful) for every petroleum canful or about 20 liters of water. Direct the spray especially to the lower surfaces of the leaves. To make the lead arsenate adhere better to the leaves, resin soap sticker at the rate of about 50 cubic centimeters per liter of the spray may be added.

3. Instead of lead arsenate calcium arsenate may be applied, using the same formula given for the former.

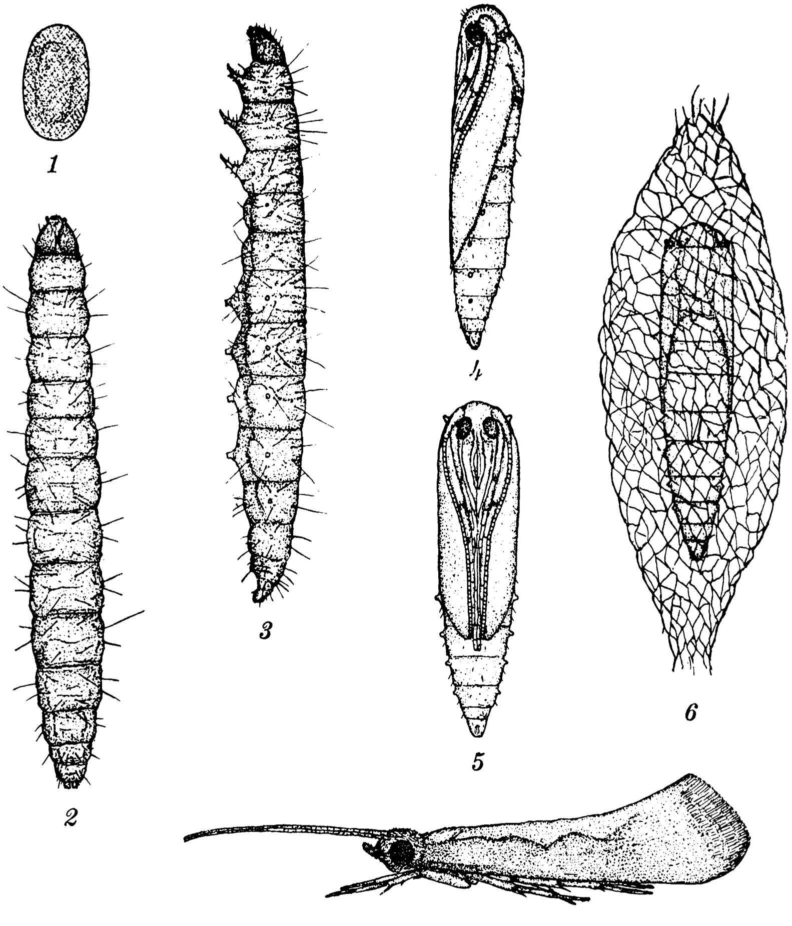
4. If aphids or plant lice and white flies are present on cabbages the following combined formula may be used:

Soft yellow laundry soap	$\frac{1}{5}$ to $\frac{1}{2}$ kilo or 200 to 500 grams.
Lead or calcium arsenate	30 to 80 grams or 6 to 16 spoonfuls, levelful.
Water	20 liters or about one petroleum canful.

[1] Life history of *Plutella maculipennis*, the diamond-back-moth. Journal of Agricultural Research, Vol. X (1917), No. 1, pp. 1–10, 2 plates.

The soap is not only deadly to the aphids and white flies but also to the caterpillars if the maximum amount of 500 grams is used. At the same time it also serves as a sticker for the lead or calcium arsenate.

5. Collecting the eggs, larvae and pupa and killing them will help reduce damage.



The diamond back-moth, *Plutella maculipennis* Curtis. (1) egg, (2) larva, back or dorsal view, (3) larvae, side or lateral view, (4) pupa, side view, (5) pupa, ventral or bottom view, (6) cocoon, and (7) adult moth, side view, in a resting position.

A REPORT ON THE CHINESE MARKET GARDENING SYSTEM

By ANIANO ELAYDA
Assistant Horticulturist

Kindly furnished with a general letter of introduction from the Chinese Consul General, the writer lately made an investigation as to how the Chinese gardeners grow vegetables in the district of Tondo and Paco within the City of Manila and between Maypajo and Caloocan, Rizal.

The investigation originally had two purposes: to study the intensive cultural methods and second to gather data on the cost of production. In view of the difficulties encountered in securing facts and figures on the money value of labor and crops produced due to the opposition of each and every individual Chinese gardener to answer questions relative thereto, the work herein reported relates to the different garden operations only.

Preparation of the land.—The laying out of the field into plots is done in such a way that practically no space is unnecessarily unoccupied. The plots are about a meter wide and of convenient lengths ranging from 5 to 6 meters long. The distance between the plots is 6 to 8 inches wide—just enough for the foot paths. The ground before planting is thoroughly prepared and pulverized. This is done by hoeing the land to a depth of about a foot with a Spanish hoe. The first hoeing is very thorough, the surface and subsoil being well mixed and pulverized. The soil of each plot is raised in two ridges leaving the greater portion of the subsoil surface exposed to the sun. Unless heavy rains fall to render the soil compact and less mellow, the ground is only worked twice before planting. Subsequent to planting and after the land is worked it is exposed to the sun from three to ten days depending upon the sanitary condition of the land observed from the crops raised from the individual plots. This is done to give land plenty of air and to kill fungi or bacteria that may be present in the soil.

Planting.—The plots before planting are worked thoroughly with the hoe and rake and the ground leveled to about 3 inches above the level of the path. The sides of the plots are raised

about an inch above the surface of the bed apparently to prevent the water and fertilizer from running off in watering or during rains. The land is fertilized by light dressing, usually put on in the morning. The fertilizer is mixed in with a rake. The plot is then ready for planting seeds or seedlings and plantings are usually done in the afternoon.

It is of interest to note that the Chinese gardeners have no nursery sheds or seed flats and so do not prepare and compost seedflat soil in which to germinate seeds and raise seedlings to transplant later to the open, considering that this system is too tedious, and increases instead of reduces labor in intensive garden management.

The practice is to germinate the seeds direct in the open field. The quantity of seeds to be sown in the plots depends upon the kind of crop to be raised. In case of crops that are to be planted and transplanted just enough seeds are broadcasted. For crops that need to be transplanted and spaced in other plots, the seeds are sown fairly thick to allow for the proper development of seedlings. Enough seedlings are left in the plots where seedlings are raised for transplanting after thinning.

Mulching.—After the seeds are sown and covered with soil, rice straw is spread over the plot thinly. The same thing is also done after transplanting seedlings. Aside from conserving moisture, as in the case of newly sown seeds, this serves to keep the seeds from being scattered and washed out when watering and during rains. The mulch is subsequently covered with soil and allowed to rot.

Fertilization.—Fertilization is one of the principal determining factors in intensive vegetable culture. The only fertilizer now used by the Chinese gardeners is lumbang cake in pressed solid form. This is broken into pieces and soaked in water in wide-mouthed pots for about 24 hours, to become soft. It is pulverized by hand and dried in the sun until it becomes slightly moistened and then screened through basket sieves when it is ready for use.

The first application of fertilizer is just before the seeds are to be sown or seedlings are to be transplanted by hand broadcasting in light dressing. The fertilizer is mixed with the soil with a home-made hoe. The frequency of application up to the time when the crop is ready for the market depends upon the growth of the plants. At least three applications are made in light dressings and the increase depends upon the growth of

the plants (the poorer and slower the growth of the plants, the more fertilizer is added).

Before the application of fertilizer to the growing crops, the soil on the path between the plots to be fertilized is hoed; then the fertilizer is broadcasted and this operation is followed by the soil-mulching of the plots taken from the path between the plots. The soil is spread practically even by the forward throw of the hoe.

Watering.—Wells about 5 meters wide are dug in different parts of the field, and are provided with steps so that a man can go down and dip his pair of wooden pails into the water easily. This arrangement economizes time and facilitates watering.

The pail for watering is so constructed that when the water is poured out it falls in a thin mist over a wide superficial area. This is a far better way of watering than ordinary sprinkling, both because it is easy and because it does not beat down the tender young newly sprouting seedlings.

Water is one of the principal needs in raising vegetables and to its use by the Chinese gardeners is mainly due their success as to quality as well as quantity. The volume of water given to each plot (1 by 5–7 meters) for each application is two pailfuls—equal to 2 petroleum canfuls (10 gallons) and the frequency of application depends upon the susceptibility of the kind of crops being grown to the heat of the sun. Ordinarily from 3 to 5 waterings are given daily for each crop during sunny days. The practice of watering the plants liberally but once in the afternoon or evening is in contrast to the method of the Chinese gardeners. They claim that leaf crop vegetables especially are forced to grow earlier with better eating qualities of leaves by giving water as above explained than by watering them liberally but once in the evening as the leaves become tough and the growth is slower. The growing plants and the newly sown seeds are never allowed to suffer from the intense heat of the sun. Even if the soil is still wet, water is applied as soon as the leaves show signs of suffering from heat.

Cultivation.—The tillage of the land before planting being thorough and the crops raised being short-lived plants, no cultivation is given the plants, except hand weeding. The closeness of planting, the nature of the root systems (spongy and shallow), the short period for maturing of the crops, and the nature of the soil (sandy loam)—all these considerations, they believe, make cultivation unnecessary and expensive.

Vegetables grown.—The 20 Chinese gardeners in the places investigated raise the same kinds of vegetables; namely, cabbages, onions, petchay, lettuce, kinchay, mustard, tañgo, spinach and peppers, all in great demand in the Manila markets.

The methods of planting in vogue are solid planting and successive and companion cropping. The latter method of planting are so planned that there is no loss of time and no space unnecessarily wasted. One crop follows another in succession.

The different intercroppings or companion croppings observed in the field are as follows:

1. *Peppers—kinchay—petchay.*—The peppers are planted in one or two rows and the petchay and kinchay are broadcasted thinly. The last two are harvested simultaneously and the peppers left until all the fruits are harvested and removed after they cease fruiting.
2. *Cabbages—onions.*—The onions are harvested as a green crop first and the whole space left to the cabbages. These are both transplanted crops.
3. *Tañgo—onions.*—Tañgo is also harvested first and the space left to the onions. Tañgo is broadcasted and onions transplanted in rows.
4. *Onions—kinchay.*—The latter is broadcasted and harvested first and the former is transplanted.
5. *Peppers—kinchay.*—Peppers planted in two rows and kinchay broadcasted and harvested first.
6. *Onions—lettuce—peppers.*—The onions are planted in 6 rows; lettuce planted in between the onion plants and peppers planted in a single row in the middle of the plot.
7. *Peppers—mustard.*—Mustard is broadcasted and harvested first.
8. *Cabbages—peppers.*—Peppers planted in a row.

From the time of planting up to pulling or harvesting the crop for the market, the maximum marketable age of kinchay is 3½ months; mustard, 2 months; petchay and lettuce, 1½ months and tañgo and spinach, 50 days. The cabbages are left until fairly good-sized heads are formed. The peppers are pulled up when the plants bear no more fruits and the onions to be sold as greens are left until fairly good-sized bulbs are produced with the idea of using both the bulbs and leaves for food.

Rotation.—Rotation of crops was observed. The purpose, based upon information acquired, is not to deplete the soil and produce poor plants and also to destroy either bacteria or fungi attacking crops successively raised on the same plot 3 times over at most after which another kind is planted.

SUMMARY

Painstaking labor in all ways—soil preparation, fertilization and watering are the distinguishing factors that account for the success of the Chinese gardeners in and around Manila. By these means they produce large quantities of good vegetables in the shortest time possible.

The land is thoroughly prepared before planting and no cultivation is practiced thereafter except hand weeding.

Raising crops by broadcasting seeds or preparing seedlings for transplanting is done direct in the open field.

The kind of vegetables raised demand practically the same cultural treatments so the attention of the gardener does not need to be diverted to other methods required by other garden crops. Only vegetables most commonly used by the public are raised.

Companion cropping is practiced to secure maximum returns from very limited space of the ground.

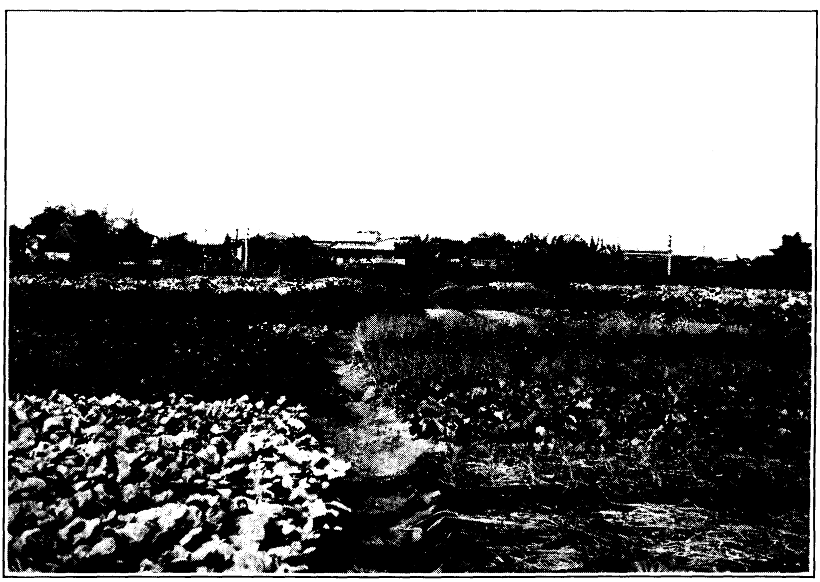
Spanish hoes, home-made rakes, and wooden pail-sprinklers are the only tools used by the Chinese gardeners.

Lumbang cake is the only fertilizer used.

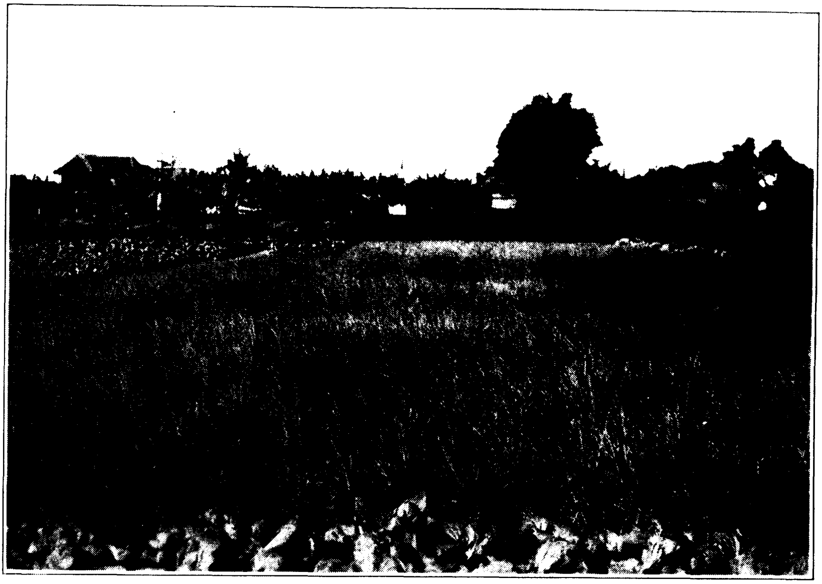
(*a*) Chinese gardener spreading soil for mulching after broadcasting fertilizer; straw mulching and companion cropping

(*b*) Partial view of a Chinese garden and a Chinaman watering

(*a*) General view of a Chinese garden



(*b*) Solid plantings and inter-cropping



(*a*) Solid planting of onions

(*b*) Workers sorting vegetables for the market

SOME EXPERIENCE IN RICE HYBRIDIZATION [1]

By JUAN P. TORRES, *Agricultural Assistant*

Various experimentalists have advocated different methods involved in emasculation and hybridization work with rice flowers. One of these investigators, Sharnngapni (1), economic botanist of Bengal, declared that "the inner glumes are delicate, protective in function and form a part and parcel of the mature seed," hence the seed would not set if these inner glumes were in any way injured. Thus he recommended a method of emasculation by gently pulling the glumes apart with the fingers—no forceps should be used—and then removing the stamens by means of a pair of fine bent forceps. This operation should be done two hours before the flower opens. After the flower is emasculated and pollinated the glumes are closed and tied up to keep them in their natural position.

But, as a matter of fact, the inner glumes are not as delicate as the Bengal botanist thought. At Alabang Rice Experiment Station, several hundreds of rice flowers were cut at about half the length of their flowering glumes and allowed to self-fertilize under cover. Nearly one hundred per cent of the flowers so treated developed seeds in spite of such rigorous treatment. This evidence proved that cutting the inner glumes alone would not hamper the development of a fertilized egg. The failure to develop seeds from emasculated and artificially pollinated flowers may thus be attributed to various other causes, such as (*a*) mechanical injury of stigma during emasculation or pollination process with brush or other instrument, (*b*) immaturity of stigma which lacks stigmatic fluid necessary for the germination of pollen grain, (*c*) over sensitiveness of the stigma to fresh foreign pollen grain as observed by Hartley (2). The other causes of failure to set seed may be the immaturity of the pollen grain, especially when it is gathered before it is naturally dehisced from its anther. Or else, the pollen grain may have lost its vitality on account of some inimic substances in the pollen container.

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[1] The author wishes to acknowledge his obligations to Mr. Victorino Borja, agronomist in charge of the Alabang Rice Experiment Station, Alabang, Rizal, not only for furnishing the author with some references on this subject but also for his kind suggestions when this paper was being written.

Just recently the Alabang Rice Experiment Station has succeeded in evolving an improvement of the method previously reported by the author (3). The flowers after the inner glumes were cut and emasculated, were inclosed in a piece of fresh banana leaf sheat folded lengthwise. This procedure prevents rapid evaporation from the cut surface of the inner glumes, which would cause the withering of the flower and thus hinder the subsequent setting of seed. Under field conditions where the atmospheric humidity is rather low and the wind may blow at any time, the use of a fresh banana leaf sheath for inclosing the emasculated and artificially pollinated flowers is of practical value in hybridization work. This protective banana leaf sheath is supported by a stick to keep the plant in its natural upright position. However, in the green house where humidity, sunlight and wind may be kept under control, a glassine paper tube is sufficient to protect the emasculated flowers from excessive drying. This method was used with good success by Mr. Chow, a graduate student in the University of Wisconsin, Madison, Wisconsin, U. S. A. The writer saw his rice breeding work when he visited that institution in June, 1926.

Cutting the inner glumes before the emasculation has a decided advantage over the method recommended by the Bengal botanist. The cutting process may be performed even a day or two in advance of fertilization or before the stigma reaches its receptive stage. It also facilitates repollination process whenever it becomes necessary. In other words, it will enable the experimenter to make many more crosses than he could by the other method of emasculating rice flowers. Now, it is important to find out which of these two methods will give the greater success: that by cutting the inner glumes or by pulling them apart with the fingers.

Collection of pollen and pollination process.—It is essential that the collected pollen be kept in an absolutely dry container. A little moisture or any form of liquid is detrimental when it comes in contact with stored pollen grain. Pollen grain for hybridization work may be kept in a dry clean glass vial. At this station it was found that ordinary typewriting paper—not the onion skin paper—folded double can hold pollen grains for two or three days without any appreciable loss of their vitality. Plain typewriting paper is very handy in collecting dehiscing pollen grains from the plant.

Artificial pollination may be done with the help of the fine point of a clean knife or scalpel. When pollen grains are dry, free from surrounding moisture, they are loose and can be discharged without much difficulty from the point of the knife to the stigma of the emasculated flower. This process obviates crushing the stigma as is likely to happen if a brush is used in applying pollen to the delicate stigma of the rice flower. Incidentally, in a single case, fertilization was effected by simply shaking a panicle with dehiscing pollen over some flowers emasculated two days before.

Fertilization.—In order to effect fertilization both the stigma an the pollen grain must meet each other while in their functional stage. In an early report (3) the author has stated that when the rice flower opens under normal field conditions it is a positive sign that the pollen grain will serve its function and the stigma is in the receptive stage. However, one must remember that certain varieties of rice like Inantipolo may produce flowers which become fertilized and ovaries subsequently develop normally without passing through this phenomenon of opening their inner glumes. In varieties where this flower opening is a normal occurrence one may pollinate the emasculated flowers at the same time the flowers of similar age in the sister panicles begin to open. At the receptive stage of the stigma the style elongates a little (3) and some colorless stigmatic fluid is ejected therefrom.

In thirty-six to forty-eight hours after pollination the effective fertilization may be detected. The growing ovary becômes sufficiently large to be observed through a 12-X magnifying hand lens. Failure to show this enlargement of ovary necesitates repollination. According to Wiegman (4), foreign pollen takes hold of the stigma with much greater difficulty than does its own, and in order to obtain complete fertilization one must often deposit it several times, even when foreign pollen is from a plant of the same species.

Ratooning.—One of the possible methods that will enable us to cross an early with a late flowering variety of rice is by ratooning the early flowering variety. An experiment for the purpose of determining the proper stage at which an early variety should be cut so as to induce ratoon flowering that will come up at the same time with a given late variety is still in progress and therefore, no results will be given in the present report.

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SOME HINTS ON THE PROPAGATION OF THE AVOCADO

(*Persea gratissima*, Gaertn)

By JOSE DE LEON
Assistant Horticulturist

The avocado is one of the most highly valued plants introduced into the Philippines, in recent years. This is due, not only to its delicious and very nourishing fruit, but also to its adaptability to the soil and climate, in many parts of the Islands.

The importation of avocado fruit from a number of countries where the Mediterranean fruit fly (*Ceratitis capitata*) is found, is strictly prohibited by the Government, due to its fear of introducing that dreaded insect into this country. As Hawaii, which, formerly, supplied most of the fruit and seed material imported into this country, is included in this quarantine, the Philippines now has to depend upon its own production for most, if not all, of its requirements of avocado fruit and seed.

Although there are already quite a number of avocado trees growing here and there in the Islands, the fruit is still very scarce and costly, and the amount of nursery material is likewise very limited. The number of seeds obtainable in the Islands can be increased more than twice by following the operations, herein described in germinating the avocado seeds. These operations are based upon experiments conducted in 1925 and 1926, at the Tanauan Citrus Experiment Station, on the propagation of the Cardinal avocado, and are believed to work similarly with most other varieties of avocado.

Operation No. 1.—The avocado seed has two, almost equally sized lobes of the endosperm. These are separated by prying them apart. These halves are planted separately, as individual seeds. The experiments at Tanauan have shown that all of the halves of seeds have given perfect germination, in spite of the fact that some of them did not contain any seed embryos at all because they clung to the other halves.

Operation No. 2.—Quite often two or more shoots grow from a germinating seed. These shoots are separated, when they are two to four inches long, by cutting them apart with a very thin, sharp knife, and replanting them separately. It is best when-

ever possible, to have with each shoot a piece of the endosperm attached, and a portion of the root system, as the shoot will develop faster than when it lacks one of these. It has been observed, however, that a separate shoot with only a part of the endosperm, or with only a portion of the roots system attached, when replanted in good soil will also develop quickly into a perfect plant. It should be remarked, in this connection, that the rapidity with which the plants develop, in the beginning, is in direct proportion to the size of the endosperm accompanying the shoots.

THE CAIMITO

By Felipe Padolina

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HISTORY

The Caimito, *Chrysophyllum cainito* is a fruit of West Indian origin. It was introduced in Ceylon in 1802. In the Philippines it was first introduced sometime in 1913 from India and later on seeds were obtained from other places in the tropics, and from Germany. This fruit is known as the "Star apple" in the English speaking colonies and as the Caimito in French and Spanish speaking colonies.

DESCRIPTION

The Caimito is a fairly large ornamental looking tree, attaining a height of about 8–10 meters. The leaves are ovate-oblong measuring from 6.1 to 17.9 centimeters long and 3.4 to 7.5 centimeters wide, pointed, leathery, dark green above and copper colored underneath.

The flowers are purplish white in color, and small and inconspicuous.

The fruit is indehiscent, oblong to roundish, weighing 140 to 260 grams, 7 to 8.8 centimeters long and 5.2 to 7 centimeters in diameter. The surface is smooth, somewhat glossy, light green in color turning to dull purple when ripe and light green in some varieties. When the fruit is cut transversely, immediately under the thin tenacious skin is a soft layer of flesh, somewhat granular, concolorous with the skin, not very juicy; inclosed by this are 8 to 10 translucent whitish segments in which the seeds are embedded. When the fruit is halved transversely, these cut segments present a starlike appearance, hence the common name. Normally, there is one seed to a segment, but frequently several are aborted leaving only four to eight seeds in the fruit. The flesh, pulp and segments (kinds of flesh) are sweet, with the characteristics sapotaceous flavor. The seeds are ovate to eliptical in shape, flattened, about 2 centimeters long, hard, brown and glossy. The fruit is eaten

fresh when fully ripened. If picked immature it is astringent and contains a sticky white latex. It is claimed that it can be made into preserves. The fruit is analyzed as follows:

	Per cent
Water	88.53
Ash	0.39
Crude fiber	0.86
Protein	2.34
Fat	1.38
Sugar	4.40
Waste	13.10
Calories per kilo of food	392

SOILS AND CLIMATIC REQUIREMENTS

The caimito is not a very delicate plant. It grows well both in shallow and deep clay loam soils where there is a prolonged dry season, but it thrives best in deep rich and well drained soil. It is said that it can be grown even in sandy soil. It is well adapted to Lamao conditions where it bore fruits between the fifth and sixth years. It is worth while cultivating as a commercial fruit.

DISEASES AND PESTS

So far no disease has yet been found affecting it and birds and wild cats are the only pests found destroying the fruit but only to a very slight extent.

PROPAGATION

The caimito is commonly propagated by means of seeds but since 1924 it has been successfully propagated by grafting on the Caimitillo, *Chrysophyllum oliviforme,* a plant which belongs to the same family and is of the same origin. It can also be propagated by means of marcotting, although it is rather difficult to induce it to root, and by budding.

PLANTING DIRECTIONS

In planting it, holes of about 60 centimeters wide and 60 centimeters deep 10 to 12 meters distance apart, should be dug, and the seedlings planted not deeper than they were planted in the nursery bed or in bamboo tubes or pots. If the plants are planted in bamboo tubes simply split the tube into halves leaving one-half of the tube in the hole so as not to disturb the roots. If planters are planted in beds care should be taken to cut off the injured or broken roots before planting. The hole in which the plant is planted should be filled with rich, mellow, well-drained soil whenever possible. The soil in the hole should be

made compact enough so as not to leave any air vacuum around the roots of the plant and no depression around the stem in which water will stand after watering.

If manure is to be mixed with the soil, only well-decayed manure is recommended.

The seeds germinate in from 18 to 39 days.

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ANTHRACNOSE DISEASE OF MANGO IN THE PHILIPPINES [1]

By FELICIANO M. CLARA
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A disease of mango (*Mangifera indica L.*) known as anthracnose has been the cause of occasional decline in the production of mango fruits during certain seasons. The popular belief attributes the casual factor to showery weather when mango trees are in bloom. Although shedding of the flowers may be partly occasioned by physiological disturbances, the real cause of the trouble is a fungous organism attacking the flowers, leaves, fruits and other parts of the plant. Climatic conditions are a contributing factor in the development of the disease. Since weather forces are not within the control of human power, it is only the disease that need concern the growers.

SYMPTOMS

On the stem and leaves.—The disease may be found on practically all parts of the plants. Upon the stems brown spots appear more or less oblong, while on the leaves they are light to dark brown and generally circular to irregular in shape. Leaf spots are very noticeable both on matured and the purplish tender young leaves, particularly on seedlings. In serious cases many of the leaves are attacked, which greatly hinders the normal development of the plant.

On flowers.—Mango tree owners sometimes have the experience of having abundant mango blossoms but few fruits. Invariably the trouble is the falling off the flowers, during showery weather when the trees are in bloom. The signs of the disease are the presence of brown to dark spots more or less circular on the peduncles and flowers. Later on, the diseased parts including the peduncles which usually remain bare on the stem even, long after the flowers have fallen off, become black.

On fruits.—The symptoms of the disease are not very noticeable while the fruits are in the green stage but as they ripen, brown to dark spots more or less circular at the start and later

[1] Bureau of Agriculture Circular No. 209.

on, assuming various shapes and sizes, appear very distinctly. The lesions may become depressed and sometimes produce black pustules, and pinkish tuft. The latter represents the fruiting bodies or spores of the fungi. The pulp beneath the spots usually becomes hard in texture and black in color, but in over ripe fruits these parts sometimes become soft. The disease causes an unsightly appearance and contributes to the rapid decay of the fruits, thus lowering the price and often making the fruit unfit for food. As high as 39 per cent storage decay has been noted by actual count. Under favoring conditions, much greater loss may result. Fruits bruised by twigs and leaves on windy or when being gathered and packed for shipment are easily attacked by the disease.

CAUSE OF THE DISEASE

Shear and Wood [1] *found glomerella cingulata* S. & v. S. as the cause of the mango blight in Florida.

According to Ocfemia and Agati [2] antracnose of mango (and of the avocado and upo in the Philippines) is also caused by *Glomerella cingulata* (Stonem) S. & v. S. The driter's observations in connection with a study of anthracnose fruit-rot of mango and its possible control, revealed identical causal organisms with the exceptions of some cases of rotting associated with species of *Rhisopus, Aspergillus and Penicillum.* The Anthracnose fungus however seems to be the principal cause of mango fruit-rot. The organism remains on the different part of the host—on fallen flowers, stems, leaves, dried up fruits and other hosts, living over to the next season in a more or less active form. Warm weather with intermittent showers during the blooming period, favor the development of the disease. Dissemination of the fungus spores is by means of insects, rain, wind and other factors coincident with injudicious cultural practices.

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[1] Shear, L. C. and Wood, Anna, K. identified *Glomerlla cingulata* S. & v. S. as the cause of mango blight in their studies of the fungus parasites belonging to the genus *Glomerella.* (U. S. Department of Agriculture Bureau of Plant Industry Bulletin No. 252, 1913.

[2] Ocfemia and Agati in 1925 reported *Glomerella cinguala* S. and v. S. as the perfect stage of the causes of anthracnose of mango, avocado and upo in the Philippines. (Philippine Agriculturists, Vol. 14, 4: 199–215, 1925.)

OTHER PLANTS KNOWN TO BE ATTACKED BY THE DISEASE IN THE PHILIPPINES

The disease deserves study as a number of other plants are also known to be affected. In the Philippines Ocfemia and Agati have reported the disease occurring on the avocado (*Persea americana* Mill), mango (*mangifera indica* L.) and upo (*Lagenaria leucantha* Lam. Rusby) and have successfully inoculated the banana (*Musa sapientum* L.) abaca (*Musa textilis* Nee) citrus (*Citrus limonum, C. nobilis,* and *C. decumna*), papaya (*carica papaya* L.), camias (*Averrhoa bilimbi* L.), eggplant (*Solanum melongena* L.), guanabano (*Anona muricata* L.), ates (*Anona squamosa* L.), guava (*Psidium guajava* L.), tomato (*Lycopersicum esculentum* Mill.) and pepper (*Capcicum annum* L.) *Anthracnose* of Para rubber (*Hevea brassiliensis* [HBK.] Muell-Arg.) seedlings associated with *Glomerlla cingulata* S. and v. S., was noted, by the writer at the Singalon Propagation Station and on specimens received from Cebu. It is probable that many other plants are attacked by this fungus.

HOW TO USE THE TRIANGULAR SYSTEM OF FERTILIZER EXPERIMENTS[1]

By JUAN P. TORRES
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Many investigators have found the triangular method to be admirably suited for experimenting on the effects of all possible ratios of fertilizer elements, such as NH_3,P_2O_5 and K_2O. It is for this important reason that this paper has been prepared. The original paper, which tells of various projects in which this system has been adopted, was published by Oswald Schreiner and J. J. Skinner in the Journal of American Society of Agronomy, Vol. 10, No. 6, 1918.

THE USE OF THE TRIANGULAR DIAGRAM

A diagramatical representation of the triangular system of fertilizer experiments is shown in figures 16 and 17. All the possible ratios of the three fertilizer constituents, NH_3, P_2O_5 and K_2O, in 25-per cent stages are shown in figure 16; and in figure 17 are represented all the possible ratios in 20-per cent stages. The term 100 per cent, as here used, means the maximum quantity of a single fertilizer constituent chosen for the experiment.

In 25-per cent stages, there are 15 possible ratios as indicated in figure 16. Obviously, this number was obtained by dividing each side of the equilateral triangle into four equal parts, and then connecting these points of division by means of straight lines as shown in the diagram. Now, this triangle represents single fertilizer constituents at the vertices or apices; mixtures of two along the sides of the triangle; and mixtures of all three constituents within the triangle. With respect to NH_3 alone, therefore, point 1 or apex NH_3 represents 100 per cent NH_3, i. e., the full amount of that single constituent allowed to be applied; the line 2–3, below the apex NH_3, is representing 75 per cent of the full amount of this fertilizer element; the second line, 4–5, still farther down, 50 per cent; and the third line, 7–10, 25 per cent, but line, 11–15 the side forming the base of the triangle opposite the apex NH_3, represents 0 per cent of

[1] Bureau of Agriculture Circular No. 210.

this fertilizer constituent. It may be seen clearly enough from the foregoing statement that the parallel lines indicate the different 25-per cent stages of the fertilizer constituent represented at the apex or vertex of the triangle and that the gradation depends upon the relative distance of these lines from their respective apices or vertices. Take the case of P_2O_5 on the left-hand vertex, the gradation in 25-per cent stages will be represented by the line 7–12, for 75 per cent; line 4–13, for 50 per cent; and so on, and the vertex itself denoting 100 per cent P_2O_5. Any point of intersection represents a ratio or combination of two constituents when on the side of the triangle, and of all three when inside of it. In Table I is given the composition represented by each point in figure 16. It will be seen

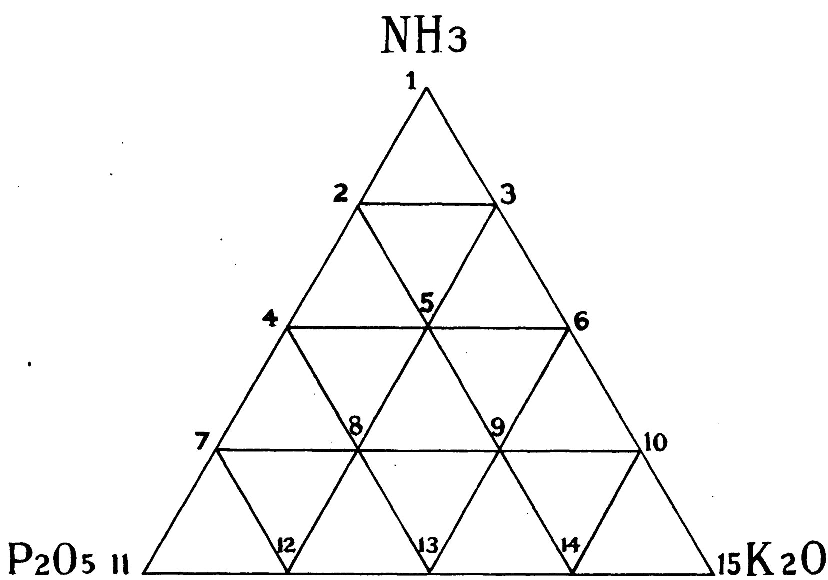

FIG. 16. Triangular diagram with points numbered, representing the fifteen fertilizer combinations, in 25-per cent stages

in both Table I and figure 16, that the intersection or point 2 represents NH_3, P_2O_5 and K_2O in the ratio, 75:25:0 per cent, while point 3 indicates these three fertilizer constituents in the proportion of 75:0:25 per cent. But point 5, within the triangle, represents the combination of all three fertilizer constituents in the proportion of 50 per cent NH_3, 25 per cent P_2O_5 and 25 per cent K_2O.

In figure 17 are given all the possible ratios of three fertilizer constituents in 20-per cent stages. Table II gives the composition represented by each point in figure 17. The different proportions or ratios in this case were obtained by the same

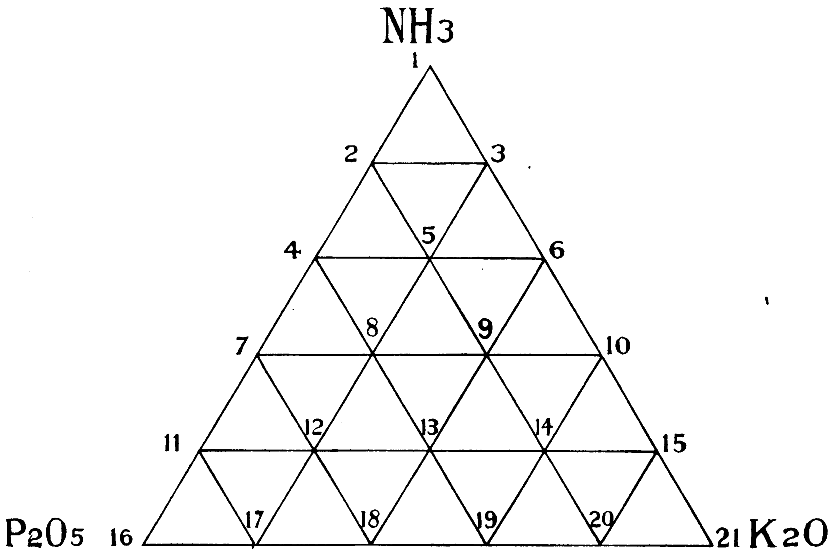

FIG. 17. Triangular diagram with points numbered, representing the twenty one fertilizer combinations, in 20-per cent stages

system which was described in the preceding paragraphs with slight modifications. Each of the sides of the equilateral triangle was divided into five equal parts, instead of four, each division representing 20 per cent of the full amount of the fertilizer constituents chosen for the experiment.

PREPARATION OF THE FERTILIZER MIXTURES

In order to understand clearly how the fertilizer mixtures may be prepared, it should first be assumed that a test of sodium nitrate, acid phosphate and potassium chloride is to be made, and the test plats are to be 100 square meters in size, and that the fertilizers are to be applied at the rate of 50 kilos of active fertilizer constituents per hectare. This means that the single maximum applications of NH_3, P_2O_5 and K_2O would be 50 kilos per hectare.

Before weighing the fertilizers it is necessary to have on hand suitable containers numbered 1 to 15 corresponding to

the number of points or intersections in the diagram, or else to the different plats. Then the amount of fertilizers required by each plat should be calculated and weighed as follows:

Sodium nitrate.—If the sodium nitrate contains 16.3 per cent NH_3 and the maximum application is to be made at the rate of 50 kilos per hectare, then, 306.7 kilos of this substance will be required for one hectare of land. Therefore, a plat of 100 square meters will require 3.067 kilos of sodium nitrate. This amount should be put in container No. 1. Containers 2 and 3 should receive 75 per cent of this amount, or 2.300 kilos; containers 4, 5, and 6 should receive 50 per cent, or 1.533 kilos; while containers 7, 8, 9, and 10 should receive only 25 per cent or 0.767 kilo of sodium nitrate, but containers 11 to 15 inclusive should receive none of this substance.

Acid phosphate.—If the acid phosphate analyzed 14 per cent P_2O_5, then, 537,15 kilos will be needed to have 50 kilos P_2O_5 per hectare. Therefore, a plat of 100 square meters will require only $\frac{1}{100}$ of this amount, or 3.571 kilos, and this quantity is to be put in container No. 11. Containers 7 and 12 should receive 75 per cent of this amount, 2.678 kilos of acid phosphate, and so on for the rest of the containers as shown in the figures in Table III.

Potassium chloride.—If the potassium chloride containers 51 per cent K_2O, then, it will require 98 kilos of this substance to have 50 kilos of K_2O for one hectare. A plat of 100 square meters will need 0.98 kilo of potassium chloride. This amount of potassium chloride is to be put in container No. 15. The other containers should receive the different amounts according to figures in Table III.

The manner in which the fertilizer mixtures should be prepared in the case of 20-per cent stages is similar to that which has just been described. In this particular case, however, it will require 21 receptacles properly numbered from 1 to 21, since there are, in 20-per cent stages, 21 possible ratios.

LAYING OUT OF EXPERIMENTAL PLATS

Fertilizer tests either in tumblers, tubes or pots may be arranged without difficulty in the form of a triangle as represented in the diagram. This arrangement at once enables the experimenter to observe the effects of the different combinations of fertilizers on the growth of plants. Besides it would be easy

to set up a duplicate or a triplicate one in a similar fashion as the original tests. The fertilizer tests in small plats may be arranged also in the form of a triangle, but that would cause more difficulties. It would be necessary to provide paths sufficiently wide to prevent any possible contamination of the different treatments. When check plats are required arrangements may be made to have same at convenient intervals as was done in certain triangular experiments referred to by Schreiner and Skinner.

If the size of the plats is from $\frac{1}{50}$ to $\frac{1}{20}$ of a hectare or more, the triangular arrangement of the test plats would become, in most cases, impracticable. Fifteen to 21 large sized plats to be arranged in the form of a triangle would certainly require an extra big piece of land. It is essential that land for fertilizer experiments should be level and should have as uniform soil conditions as possible. It is therefore more practicable to arrange the experimental plats in a rectangular fashion, with the plats numbered according to the numbers in the triangular system. The rectangular arrangement would not necessarily affect the results of the experiments.

OTHER APPLICATIONS OF THE TRIANGULAR SYSTEM

The triangular system has been employed in many different kinds of research work. This system had its first application in connection with the study of nutrient solutions, their physiological effect upon plants; their effect upon the exchange of ions by plants growing in solution cultures. It has been used also in connection with the study of certain media employed for bacteriological examination of water. Besides it has been used in the study of the effect of certain toxic organic compounds (such as cumarin, vanillin and quinone) on the growth and nutrition of certain plants, and in the study of the effect of certain alkali salts on the germination and growth of various plants. The triangular system has been adopted also in connection with certain nutrition problems with orchard trees in which 4 to 9 trees in group were treated as a unit.

TABLE I.—*Fifteen possible ratios of the three fertilizer constituents, NH_3, P_2O_5 and K_2O in 25 per cent stages*

Point No.	NH_3	P_2O_5	K_2O
1.	100	0	0
2.	75	25	0
3.	75	0	25
4.	50	50	5
5.	50	25	25
6.	50	0	50
7.	25	75	0
8.	25	50	25
9.	25	25	50
10.	25	0	75
11.	0	100	0
12.	0	75	25
13.	0	50	50
14.	0	25	75
15.	0	0	100

TABLE II.—*Twenty one possible ratios of the three fertilizer constituents, NH_3, P_2O_5 and K_2O, in 20 per cent stages*

Point No.	NH_3	P_2O_5	K_2O
1.	100	0	0
2.	80	20	0
3.	80	0	20
4.	60	40	0
5.	60	20	20
6.	60	0	40
7.	40	60	0
8.	40	40	20
9.	40	20	40
10.	40	0	60
11.	20	80	0
12.	20	60	20
13.	20	40	40
14.	20	20	60
15.	20	0	80
16.	0	100	0
17.	0	80	20
18.	0	60	40
19.	0	40	60
20.	0	20	80
21.	0	0	100

TABLE III.—*Showing the quantities of sodium nitrate, acid phosphate and Potassium chloride per 100 square meters at the rate of 50 kilos of NH_3, P_2O_5 and K_2O per hectare, in 25 per cent stages.*

Container or Plat No.	Sodium nitrate (16.3 per cent NH_3)	Acid phosphate (14 per cent P_2O_5	Potassium chloride (51 per cent K_2O)
	kilos	*kilos*	*kilo*
1.	3.067	0.000	0.000
2.	2.300	.893	.000
3.	2.300	.000	.245
4.	1.533	1.786	.000
5.	1.533	.893	.245
6.	1.533	.000	.490
7.	.767	2.678	.000
8.	.767	1.786	.245
9.	.767	.893	.490
10.	.767	.000	.735
11.	.000	3.571	.000
12.	.000	2.678	.245
13.	.000	1.786	.490
14.	.000	.893	.735
15.	.000	.000	.980

TOP-WORKING OF UNPRODUCTIVE TREES[1]

By F. G. GALANG, *Horticulturist*

Fruit trees grown from seeds, no matter if the latter were picked from trees selected for quality and productiveness are always liable to show variations either in size, quality, shape, color, productiveness, etc. from the parent stock. The chances are that they may not produce the characters of the mother plants at all. But with vegetatively grown plants, the characters of the mother plants are perpetuated, though in a few cases the stock used may influence the scion or vice versa, it is believed by some investigators. The influence of the stock on the scion or vice versa, has never been determined accurately, however although some claim that the stock may dwarf tall growing scions as in the case of *Citrus trifoliata* if this is used as stock for other species of citrus.

If plants grown from seeds were not subject to variation there would now be many sweet fruits like the imported oranges growing in the Philippines. For the old folks when eating such sweet fruits often saved the seeds for planting or if they did not they throw them in the yard, and nature took care of the rest. But although these have been selling in our markets for a long time yet few sweet oranges, pomelos, etc. are to be found growing in the Islands at present.

The unfruitfulness of fruit trees may be attributed to various causes; namely, that the trees were grown from seeds, the presence of pests and diseases, the absence or excess of moisture in the soil for the best development, the overproduction of leaves because of an excess of nitrogen, insufficient fertility of the soil, unsuitable climatic and soil conditions, physical injuries of the tree or its old age.

When the tree was grown from a seed or is old it may be made to bear by top-working. This saves the expense of planting a new one, and the tree so treated produces a crop of the desired variety within a shorter time. Sometimes it becomes necessary to change the existing variety as for instance pahutan or pico mangoes may be changed to carabao mangoes,

[1] Bureau of Agriculture Circular No. 211.

a mandarin to a standard imported kind of orange, or a sour variety to a sweet one, etc. This can be done as follows:

1. The entire top of the tree is cut off and buds or scions obtained from a tree known to be precocious and prolific are inserted in the new growths when the latter are buddable. (See fig. 18.)

2. Half of the top of the tree is removed as in No. 1, and buds or scions from the desired tree are inserted at the new sprouts as soon as these are buddable. (See fig. 19.)

3. The entire top is removed and scions from a known tree are inserted at once either by cleft or side grafting. Side grafting can only be performed on those trees that have bark that comes off easily while cleft grafting can be performed on any kind. (See fig. 20.)

The first method is in most cases, the surest, easiest and most satisfactory in the tropics. The second method does not produce quick results on some fruit trees, like the mango, because the development of the new sprouts is quite slow, the plant food being absorbed by the remaining branches. On the other hand in the case of camias (A. bilimbi), mabolos (D. discolor), and other fruit trees the second method gives better results than No. 1. The young sprouts develop faster than those where the entire top is cut off. By this method the tree can be top-worked for two, three or more years. In fact whenever this method is practicable it is advisable to top-work part of a large tree at a time only. The third method is not recommended under Philippine conditions.

Ordinarily it will take three to five months before the newly developed twigs become buddable. The time depends upon the fertility of the soil and the character of the tree. In slow growing trees it may be more than five months. Top-worked trees in many instances will flower and fruit during the next year and in the majority of cases will fruit heavily in the third year. At the Lamao Experiment Station an unproductive avocado tree was top-worked on December, 1921, the shoots budded on February, 1922, and a number of fruits were harvested in August and September of the following year.

Procedure.—All branches of the unproductive tree or, as it may be called, the stock, are removed or cut off to about 50 centimeters from the angle formed with the other branches. The operation should be performed during the dry season or better yet at the beginning of the rainy season. During this time there is little chance for the decay of the cut branches,

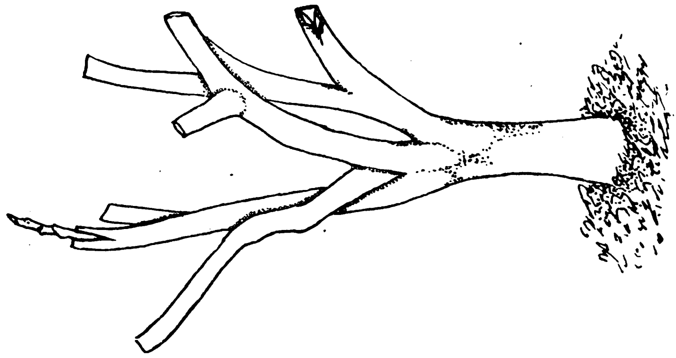

FIG. 18. Top-worked tree where the entire top is removed and new twigs are allowed to develope for budding or grafting.

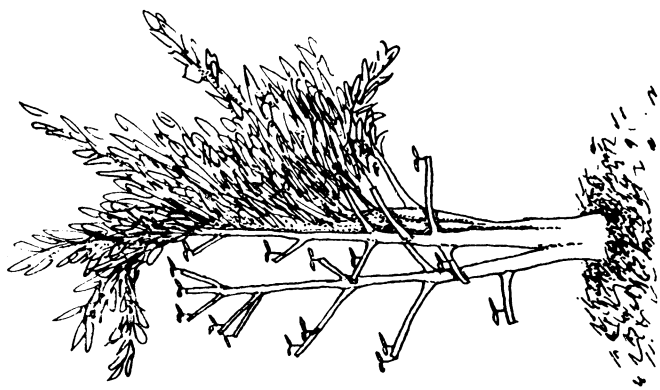

FIG. 19. Half top-worked tree.

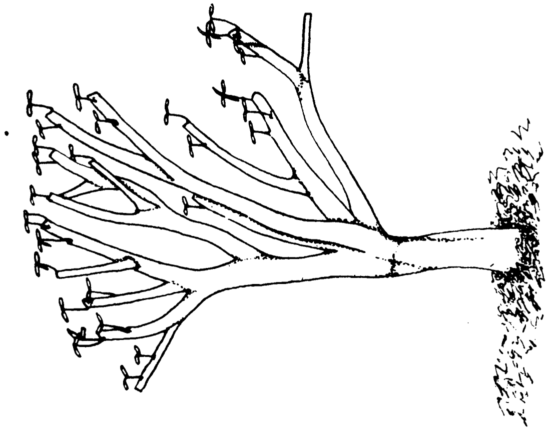

FIG. 20. Top-worked tree where the entire top is removed and grafted at once.

which if cut during the rainy season become a breeding place for insects and fungi.

In places where there are strong winds, however, it is advisable to leave part of the unprolific branches on the tree for the protection of the newly inserted buds or scions from the wind, and to shield the injured parts, and the main trunk from sun scald. Besides the branches left will maintain a continuous flow of sap. These branches should be removed as soon as the buds or scions are well developed. In cutting off the branches, a clean cut should always be made, and the exposed parts should be painted with white lead or coal-tar. The trunk should be painted with whitewash to prevent the bark from sun scald. The whitewash is prepared by dissolving air-slaked lime in water until a heavy milky consistency is produced.

When the new twigs have a good start few on each of the main branches should be selected and the rest removed. The shoots to be selected must be growing some distance apart so that when budded or grafted they will form a symmetrical tree. In cutting off the extra twigs no stubs should be left. They should be pruned off close to the main branches in order to heal quickly instead of decaying and to prevent the growing of numerous wild or water sprouts. The selected twigs should be trimmed off below to about 10 to 15 centimeters high, if branches have developed so that budding can be performed readily.

Budding or grafting the top-worked tree is performed in the same way as on young seedling stocks in the nursery; and care taken subsequently to lop off extra branches, remove wild sprouts, etc.

Budding.—First make a vertical cut through the bark through to the cambium layer of the stock, and a horizontal one at the bottom of it to form an inverted "T". Open the cut or split bark with the blade of the budding knife when the bud is to be inserted. Cut two to four centimeters of the bud from the budstick by means of a sharp knife, leaving only a very small bit of wood under the bud for its protection. The bud should be cut clean and no tissues broken, and inserted immediately inside the opened bark of the stock. It should be pushed upwards in order that no water may enter the cut. After the bud is inserted the whole wound should be wrapped in waxed cloth sufficiently tight to bring the bud in touch with the cambium layer, but not too loosely or too tightly, lest the growth be adversely affected, or as in fact oftentimes happens, pre-

vented entirely. The wound should be wrapped up to exclude the possibility of the injurious effects of dirt, moisture and air.

After 12 to 20 days, depending of course on the variety treated, from the date of the insertion of the buds, they may be examined to see if they have taken, or callused. If so the wrapping should carefully unwound until below the bud and an inspection made of each bud. The wrapper should not be allowed to remain too long around the buds, as there is a possibility of them getting overgrown by the bark of the stock, and then the natural attempt of the young growth to push out will be frustrated. After it has callused the stock may be half cut at a height of 6 inches or so and bent downward to induce the growth of the buds; and when the young bud is well developed into a young tree the top of the stock can be separated entirely by cutting close to the angle formed in the union between the stock and the scion. All wild sprouts, or what are oftentimes called water sprouts, should be removed as fast as they appear.

Cleft grafting.—Cleft grafting may be done in the top-worked tree at once or to the young twigs after the latter have developed to a buddable size. The operation is performed as follows: After the entire top is removed if it is desired to graft the tree at once, split the stock downward with a sharp knife or other suitable implement. The split should be neither too deep nor too shallow, but just deep enough for the cut part of the scion or a little more, and this can be held open by allowing the wedge portion of the knife or other grafting tool to remain in the cut portion of the stock. The scion is then cut at the base in a wedge shape as in figure 21 and 22. The cut should be made narrower toward the base similar to the "bamboo tongue" of the clarinet. The scion is then inserted into the

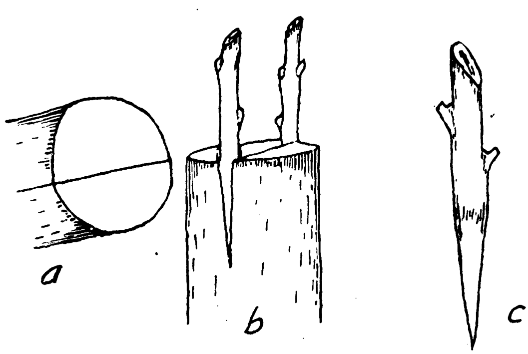

FIG. 21. Showing: (*a*) the cleft; (*b*) grafts inserted; and (*c*) a properly cut scion for cleft grafting.

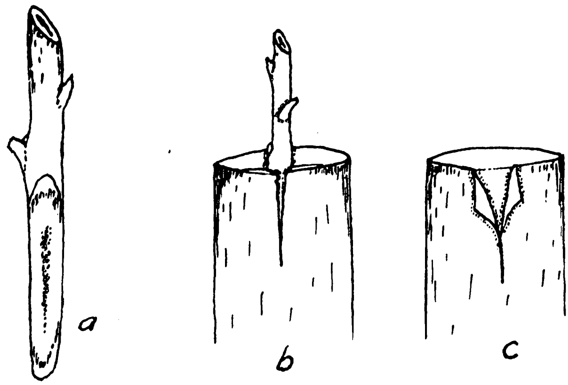

FIG. 22. Showing: (*a*) a properly cut scion for side grafting; (*b*) side graft inserted; and (*c*) opening of the stock ready for insertion of scion in side grafting.

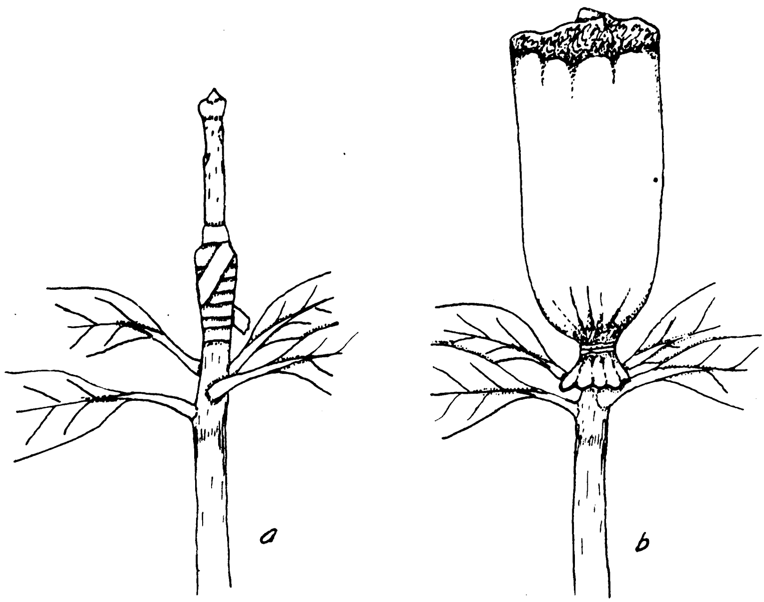

FIG. 23. Showing: (*a*) graft completed and waxed; and (*b*) the paper or light cardboard covering filled with moist moss or saw-dust.

cut portion of the stock with the thin portion toward the inside of the cleft, but care should be taken that the cambium layer of the stock and the scion should be in contact with each other. One or more scions can be inserted in the case of large stocks. The wounded portion of the stock should be sealed with grafting wax after the inserted scion and the stock have been bound together with a tape, raphia or any other suitable material. The tip portion of the scion should also be waxed. Delicate

scions should be covered with manila or some other heavy paper light cardboard so as to form a loose cylinder around the union extending a little above the tip of the scion. This should then be filled with moist moss or sawdust as in figure 6 to prevent drying by the excessive heat of the sun. In grafting the newly developed twigs in a top-worked tree proceed as per the directions given except that in this case every individual and selected twigs should be removed individually as is done with the branches of a large tree before grafting.

Many of the species can be budded or grafted with petioled scions. However, with some species of fruits trees success can only be expected by using nonpetioled budwood. By nonpetioled budwood is meant scions where the leaves have dropped off previously or naturally. In some species both ways would take. Difficulty in budding or grafting is oftimes encountered if old or immature budsticks are used, for many plants are only buddable where the scion and the stock are practically of the same age at the point of insertion of the latter.

A CASE OF TERATOLOGICAL TWINNING IN SUGAR CANE

By Anselmo Labrador

Acting Superintendent, La Carlota Sugar Cane Experiment Station, La Carlota, Occidental Negros

Teratological twinning in sugar cane (*Saccherum officinarum*) has not been reported in the Philippines. The case of teratological twinning here reported was collected by Mr. Silvestre Asuncion, former assistant sugar technologist in charge, Sugar Cane Investigation, on October 18, 1926, in a plot of La Carlota Sugar Cane–22/4. The two stalks have no sign of deviation from the normal length of internodes, nodes, eyes and the ordinary form though they were slightly smaller than the ordinary La Carlota Sugar Cane–22/4 stalk. Each stalk has the same number of nodes and eyes and almost the same length of internodes. Only one eye sprouted from every node at the first two nodes from the base, two eyes sprung closely from every node. At a glance one would think that one of the stalks sprung from the other. Looking at the cross section of the stem, (see fig. 24) shows that the two stalks are really two distinct stalks which are enclosed in the cylindrical stem at the two internodes above the base of the stem of the plant. It is probable that the two shoots grew closely together at the start were somewhat blended into one stalk and then developed into two separate stalks which gives rise to this case of teratological twinning.

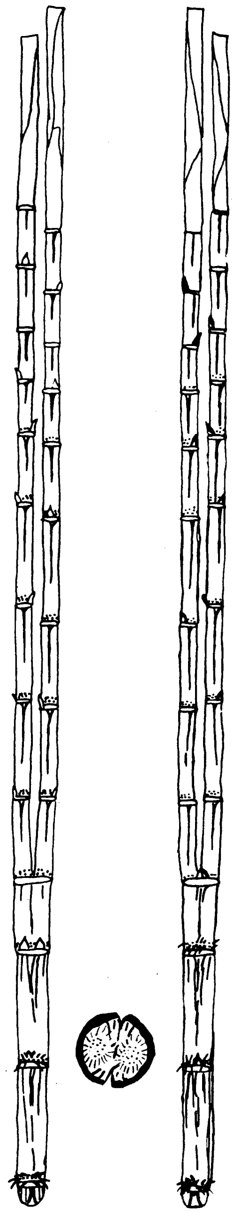

Fig. 24. La Carlota sugar cane— '22/4, Showing front view, cross section, and back view, respectively.

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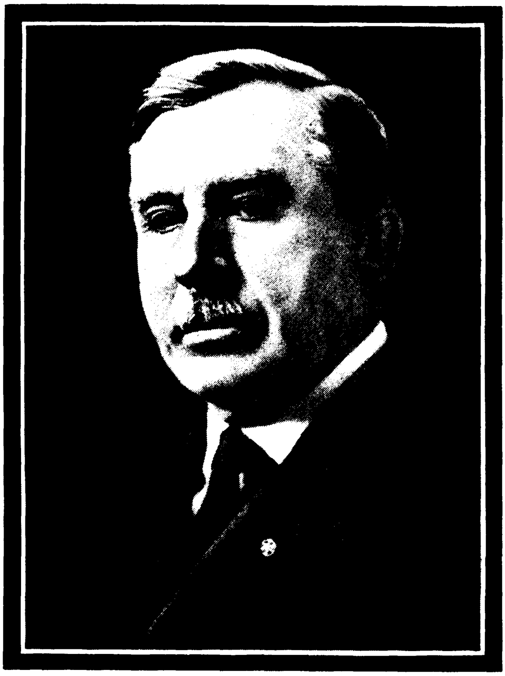

The Late LEONARD WOOD
Governor-General of the Philippine Islands
1921–1927

In his death the United States lost a great soldier and an exemplary citizen, and the Philippines an indefatigable public servant and a staunch advocate of the development of the natural resources of the Archipelago. As Governor General, he supported all measures calculated to advance Philippine agriculture.

SILVERIO APOSTOL
Acting Secretary of Agriculture and Natural Resources

THE PHILIPPINE

Agricultural Review

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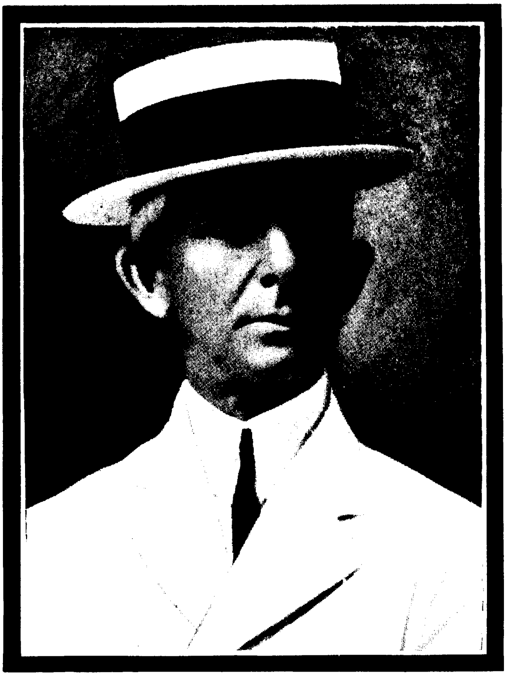

The Late CHARLES FULLER BAKER
Dean, College of Agriculture, University of the Philippines

[Died in Manila, July 22, 1927]

A leader of agricultural education in the Philippines, a constant contributor to science, an example of loyalty to duty and calling, his death is a distinct loss to the country, to the Filipino youth and to science.

STANTON YOUNGBERG
Director of Agriculture

PRELIMINARY REPORT ON CERTAIN FATTENING FEEDS FOR HOGS

By EXEQUIEL ALCACID, *Superintendent, Alabang Stock Farm*

The Philippine Islands are abmirably adapted to the production of pork, as they have almost a uniform climate suitable to pig raising. Local feed such as tiqui-tiqui (darac) rice bran or darac, cassava, corn meal, copra meal, molasses, etc., are most easily obtained and labor is cheap.

To familiarize the reader with feeds discussed in this experiment the analysis of each of them with some descriptions is given.

Corn is grown in almost all parts of the Islands. Felipe T. Adriano's (1) analysis of the yellow corn is as follows:

Moisture	Ash	Protein	Crude fiber	Carbohydrates
		(N x 6.25)		
13.88	2.61	8.90	2.86	67.28

Tiqui-tiqui is a by-product of rice mills and is available at low prices in places where there are rice mills. There are two distinct kinds of this feeding stuff. The finest one is the best rice bran and is obtained from big rice mills where the coarse part of the hulls of the rice is taken away. This by-product is a rich food in that it has a large per cent of the layer of the rice grain lying just under the hull and there is also a large per cent of the broken germ though it has less broken grain mixed with the bran. The other one is the mixture of rice hulls and the rice bran and is obtainable from small rice mills. It contains much broken grains (binlid). Analysis made by the Bureau of Science of these two kinds of darac are as follows:

"Darac" from small rice mills

	Per cent
Protein	5.94
Fat	4.00
Crude fiber	2.14
Carbohydrate by difference	71.98

"Darac" from big rice mills

	Per cent
Moisture	13.80
Ash	8.25
Ether extract	16.67
Protein (N x 6.25)	12.30
Carbohydrates by difference	42.28
Fiber	6.70

Copra meal is the ground cake left after the oil is extracted from the copra. There are also different kinds of copra meal with varying percentage of oil. The least amount of oil in the copra meal is considered the best feed for animals. Copra meal which contains a high percentage of oil will not keep long, for it becomes rancid and causes diarrhea when fed to animals. In places where coconut oil is extracted by native press and not by machine, the copra cake produced naturally contains a high percentage of oil and is not always safe feed for animals unless fresh. The present market copra meal which is pressed by machine contains 7–13 per cent oil according to the Bureau of Science. This kind of copra meal is the one mostly used at the Alabang Stock Farm and can be kept for several months without deteriorating.

Low grade or black strap molasses is very cheap in sugar-cane regions especially in places where centrals are established. There are two distinct kinds of molasses—one heavy and another light. The one used in this experiment was the heavy molasses and the total invert sugar in this, according to the Bureau of Science, is 63.03 per cent.

Cassava is a productive root crop which is planted on hilly places where grain crops do not do well. It thrives in adobe rock soil. In the rural districts it can be seen planted along the fences. It does not require as much cultivation as other crops. It is not used here as yet to any extent either for the manufacture of starch and tapioca or as a stock food. but it its very valuable crop for both purposes.

Our Lamao Experiment Station (2) reports in 1924 a yield per hectare of plantings of base, middle and top portion of cassava as follows:

Variety	Base	Middle	Top
	Kilos	*Kilos*	*Kilos*
White petioled	41,908	28,283	11,663
Intermediate	46,191	18,158	19,691
Red petioled	26,208	16,991	11,925

The root crop of these varieties of cassava were used to feed the animals in this experiment.

Cassava analysis

Variety	Moisture	Ash	Starch	Protein	Crude fiber	Hydrocianic acid in bark	Hydrocianic in edible protein
Cassava, white petioled	67.84	4.15	24.88	1.13	1.795	0.043	0.023
Cassava, red petioled	67.11	3.81	25.79	1.312	1.816	0.046	0.028
Cassava, intermediate	69.39	3.15	23.82	1.13	2.27	0.048	0.023

That the people of these Islands are getting more interested in the raising of pigs can be seen by the increase in number of hogs in the Philippine Islands. There were 2,521,100 in 1915 and 7,524,800 in 1923(3). The Philippines, however, in spite of this big increase in number imported swine products to the value of ₱15,041,537, for the years 1915 to 1923.

Because of the relative low cost of low grade or black strap molasses in places where centrals are established or in sugar regions, and because of its palatability when fed with tiqui-tiqui and copra meal as swine feed, it should be used for fattening hogs particularly in communities where the home grown feeds are not cheap. It is for the most part a carbohydrate carrier and it would seem possible that it might be substituted either wholly or partly for the corn in the ration. Corn is commonly used in the Islands as in other countries for fattening hogs, but because of its high cost here as swine feed, the question of substituting same with other stuffs which are much lower in price should be experimented. This stuff is not only used as stock feed but is used as human food. In some Visayan provinces the poorer class use corn instead of rice or mix them.

According to analysis made by the United States Department of Agriculture, Division of Chemistry(4), the roots of cassava contain a much smaller proportion of water than is found in other roots used for feeding, and so are correspondingly richer in food elements which belong principally to the fat-forming group, 89.84 per cent of the dry material being carbonaceous while only 2.59 per cent is protein.

The United States Department of Agriculture(5) says that cassava is a food far more valuable for fattening than for growing animals, and it can be produced at such a low cost that some of the more expensive nitrogenous foods as shorts, peanuts, or cowpeas can be used with it and so form a good, growing ration

at a low cost. When hogs have reached nearly their full growth, and it is desired to fatten for finishing off, it is claimed that cassava is the cheapest food known for this purpose.

The United States Department of Agriculture(6) states that many feeders use cassava exclusively during the fattening period, after the animals have reached sufficient size, and find it very satisfactory. The pork is very white in color and of fine flavor though perhaps not quite so fine as that from corn fed hogs.

Francisco P. Lago(7) experimented on hog feeding involving the use of self-feeders. Comparing corn with rice bran as basal feeds for fattening market pigs, with copra meal as supplement and sweet potatoes for pasture in both, found that the corn lot gave the better results.

Teofilo P. Elias(8) on rice bran, corn and copra meal as supplement to camote vines for growing pigs found that the pigs given rice bran and copra meal mixture as suppliment gained and thrived almost the same, the rice bran and copra meal ration being slightly the better. Under the condition of the experiments rice bran was a more efficient concentrate than corn.

Dr. Stockbridge, in Bulletin No. 49 of the Florida Experiment Station(9) states that when five lots of pigs were fed for a period of 75 days, cassava gave a greater net profit and a greater percentage of gain than did either corn, chufas or peanuts, and a greater net gain in weight than did any except corn. The cost of the increase in weight of the cassava-fed pigs was only 1.04 cents per pound, while the increase of the corn-fed pigs cost 3.06 cents per pound.

A grower at Wortham(10), Mississippi, U. S. Farmer's Bulletin No. 167 states that he regards 1 acre of cassava as being worth as much as 8 to 10 acres of corn for fattening hogs, and thinks it the cheapest feed which can be used when hogs are grown for market. He shut up three lots, all of the same breed and of nearly the same age and weight. One lot was fed with cassava, one with corn, and one with a mixture of meal and shorts, equal weight for each head being used. The hogs at the end of the period of the experiment were killed and it was found out that the cassava fed lot had made the greatest gain, having made 110 pounds for each 100 pounds made by the corn fed lot. The cassava lot were then really too fat having more fat and less lean meat than the corn lot, and a still greater difference in fat over the lot on mixed feed.

Texas Bulletin No. 131(11) on an experiment where 6 hogs were put in 3 lots, average weight 120 pounds at start, and fed for 91 days had the following results:

Lot	Kind of feed	Average daily gain	Cost per 100 pounds gain
		Pounds	
I	Corn and molasses equal parts	0.9	$10.75
II	Corn 2 parts and molasses 1 part	1.45	7.53
III	Corn alone	1.66	7.36

From Swine Husbandry, by Day—Conclusion.—Molasses proved lower in value than corn. Molasses is poor in protein and would likely have given better results if fed with a feed richer in protein than corn.

The Agricultural Experiment Station, College of Agriculture, University of Arkansas(12), using rice by product for fattening swine came to the following conclusions:

Rice bran.—It is more valuable than corn chops for fattening hogs when the two are each fed alone than when supplemented with protein supplements. Rice bran is only about 90 per cent as valuable as corn chops.

Rice bran can not be fed economically during the summer months as the oil in the germ becomes rancid and weevils work in the bran during the hot weather.

Rice bran alone or even when this is supplemented with protein supplements is not as desirable a fattening ration as either rice polish or corn chop. It is too bulky and a high finish was not attained by hogs fed on such ration.

From an economical standpoint rice bran gave better results when fed alone than when supplemented with proteid feeds.

The cheapest gain as well as about the largest daily gain were made when rice bran was used as a supplement to rice polish or rice polish and corn chops.

OBJECT

The object of this experiment was to test the comparative value of corn, cassava and molasses as fattening feeds for hogs, using tiqui-tiqui and copra meal as the basal ration.

Place where conducted.—Alabang Stock Farm in three sets under the following dates:

Set No. 1 begun April 17, 1925 ended August 16, 1925........ 121 days.
Set No. 2 begun September 13, 1925 ended December 12, 1925.. 90 days.
Set No. 3 begun September 18, 1925 ended December 17, 1925.. 90 days.

The pigs in all cases were first deprived of feeds for 24 hours before butchering to also determine the shrinkage or loss in weight in the different lots.

MATERIALS AND METHODS

There were three pigs used in the first set of experiment which were litter mates and their age at the start of the trial was 9 months. They were mestizo pigs, a cross between a Duroc-Jersey boar and a Berkshire-Yorkshire sow, the Duroc-Jersey blood being $\frac{1}{2}$, the Yorkshire $\frac{1}{4}$ and the Berkshire $\frac{1}{4}$. These three pigs were the only survivors of a litter of 15 pigs. The smallest one was put on the corn ration which is lot No. 3 and the other two which had almost uniform weights were put on the molasses and cassava lots, lots 1 and 2, respectively. The pigs on lots 1 and 3 were females and the one on lot 2 a castrated male.

In the second trial 6 pigs were used and two pigs were used in each lot. These were also litter mates and their age was 7 months at the start of the experiment. There were 7 in the litter and they were a cross between a Duroc-Jersey boar and a Poland-China sow. One castrated male and one female were put in lot 1, two females in lot 2 and one castrated male and one female in lot 3.

In the third trial three pigs were also used and these also were litter mates. They were nine months at the start of the experiment and were a cross between a Berkshire boar and a Duroc-Jersey sow. One female was lot 1, another female lot 2 and one castrated male lot 3.

The female pigs in these experiments should have been spayed as during the period of the experiment they were sometimes in heat and their appetite was lessened for several days. On the first trial notes were made of observations taken of all the female pigs in heat.

The following proportion of feeds were used in experiment No. I:

Lot 1—

10 parts tiqui-tiqui or rice bran.

3 parts copra meal.

Molasses just enough to make the slop mass taste sweet so the pigs would like it.

Lot 2—

10 parts tiqui-tiqui or rice bran.

3 parts copra meal.

Dried sliced cassava roots cooked before feeding. The amount given every day averaged 191.56 grams.

Lot 3—
10 parts tiqui-tiqui.
3 parts copra meal.
2 parts corn meal.

In the second and third trials the amount of cassava and corn were both increased to 3 parts.

The following feeds were used in Experiments II and III:

Lot 1—
10 parts tiqui-tiqui.
3 parts copra meal.
Molasses enough to make the slop taste sweet so the animals would like it.

Lot 2—
10 parts tiqui-tiqui.
3 parts copra meal.
3 parts powdered cassava roots.

Lot 3—
10 parts tiqui-tiqui.
3 parts copra meal.
3 parts corn meal.

The pigs were fed with the above feeds twice a day. Molasses was dissolved in the slop mass of the molasses lot every time feeding was done. In the case of the cassava, on the first trial it was first cooked before mixing with the mixture of tiqui-tiqui and copra meal. The cassava used was sliced and dried cassava roots. On the second and third trials this feed was powdered like tiqui-tiqui and mixed with the tiqui-tiqui and copra meal and was not cooked.

At the start of the experiment the pigs were not given full feed until the middle of the period, when they were given all they could clean up. The initial weight of the pigs was taken at the start of the experiment and the final weight at the end of the period of the experiment.

The amount of feed consumed by the pigs on the first trial was determined monthly and the feeds were put in separate boxes, while in the second and third trials this was taken weekly and the feed was put separately in covered petroleum cans to avoid error due to loss of feeds in the storage.

One of the pig sheds of the Alabang Stock Farm was used in conducting these experiments. The house is a framed structure 72 by 12 by 8 feet in size with a row of pens inside. On one side of the pen is a feeding alley running the full length of the house. The pens are 7 by 7 feet and the floor is of concrete. Each lot occupies one pen. All the pens lead to a yard of about 1 hectare in area. This is sheded with madre cacao and some

ipil trees. Ordinary grass is found growing in this area of which the pigs partake at will.

The female pig in lot 1, Experiment II was in heat November 25, 1925 to December 1, 1925.

Both female pigs in lot 2, Experiment II were in heat November 5, 1925, to November 10, 1925. And one of these was again in heat November 25, 1925, to December 2, 1925.

The female pig in lot 3, Experiment II was in heat November 5, to November 10, 1925, and in heat again November 25, 1925, to December 1, 1925.

The female pig in lot 1, Experiment III was in heat December 5, 1925, to December 10, 1925.

The female pig in lot 2, Experiment III was in heat December 3, 1925, to December 10, 1925.

COST OF FEEDS USED

The cost of feed used in this experiment is based on what the stock farm is actually paying for its feed for the animals at the time.

	Per kilo
Tiqui-tiqui, good quality from Cabanatuan	₱0.09
Copra meal from Carriedo Vidal & Co., Manila	.0793
Corn meal yellow from Calamba	.13
Molasses from Chinese, Manila	.059
Cassava produced at the farm (estimated)	.02

The following table gives the results and facts concerning the first set of the experiment:

TABLE 1.—*Experiment I*

The experiment begun April 17, 1925 and closed August 16, 1925 (121 days).
Nine-month-old pigs (Duroc-Jersey–Berk-Yorkshire.)
All females.

	Lot 1	Lot 2	Lot 3
	Molasses, tiqui-tiqui and copra meal	Cassava, tiqui-tiqui and copra meal	Corn, tiqui-tiqui and copra meal
Number of pigs in experiment	1	1	1
Days in experiment	121	121	121
First weight per lot ... kilos	75.0	74.4	67.0
Final weight per lot ... do	156.6	143.4	131.8
Total gain	81.6	69.0	64.8
Average daily gain per lot ... kilos	.674	.570	.535
Total tiqui-tiqui consumed	261.54	269.08	248.40
Total copra meal consumed	78.46	80.72	74.52
Total corn meal consumed			49.68
Total cassava consumed		23.37	
Total molasses consumed	19.68		
Total feed consumed in kilos of the different kinds	359.68	373.17	372.60
Total cost of feed consumed of the different kinds	₱30.92	₱31.085	₱34.73
Average feed eaten daily per pig	2.992	3.084	3.08
Total feed consumed for 100 kilos	440.78	540.76	575.00
Average feed consumed per 1 kilo gain	4.41	5.41	5.70
Total cost of 100 kilos gain	₱37.89	₱45.05	₱53.59
Average daily cost of ration per pig	₱0.255	₱0.256	₱0.287

In this experiment, lot 1 fed with a ration of tiqui-tiqui, copra meal, and molasses made the greatest gain but gave the lowest total amount of feed consumed for 100 kilos gain. It required 440.78 kilos of feeds to produce 100 kilos gain. Molasses is the cheapest feed and therefore economical. This lot gave the lowest gain.

Lot 2 fed with a ration of tiqui-tiqui, copra meal and cassava stands second. It required 540.76 kilos of feed for 100 kilos gain.

The lowest gain was made by the hog on lot 3 on a ration of tiqui-tiqui, copra meal and corn. It required 570 kilos of feed for every 100 kilos gain.

The cost per 100 kilos of lots 1, 2, and 3 are ₱37.89, ₱45.05 and ₱53.59, respectively, a great difference of ₱15.70 and ₱8.54 of lots 2 and 3 respectively over lot 1.

The average daily gain of lots 1, 2, and 3 are .674 kilo, .570 kilo, and .535 kilo, respectively.

The average daily cost of ration per pig of lots 1, 2, and 3 are ₱0.255, ₱0.256, and ₱0.287, respectively.

On August 18, 1925, all the pigs used in Experiment I were butchered and the live and dressed weights noted. Pictures were also taken. They were not given feed except water all day August 17, as they were butchered the next morning. The pork produced was sold at ₱0.80 per kilo.

The flavor, color of pork and condition of lard of each pig in each lot was also observed.

The following table shows the weight at the end of the experiment, the weight after the pigs were deprived of feeds except water for 24 hours, the per cent of dressed weight, the value of pork produced, the total net profit after deducting the cost of feed, the taste and color of pork and the condition of the lard:

TABLE 2.—*Experiment I*

	Lot 1	Lot 2	Lot 3
	Molasses	Cassava	Corn
	Kilos	*Kilos*	*Kilos*
Weight on August 16, 1925	156.6	143.4	131.8
Weight on August 18, 1925	149.0	136.0	128.0
Loss in weight	7.6	7.4	3.8
Dressed weight	124.0	115.0	109.0
Per cent dressed weight	83.22	84.56	85.16
Cost of pork at ₱0.80 a kilo	99.20	92.00	87.20
Cost of total feed consumed	30.92	31.087	34.73
Net return after deducting the cost of feed	68.28	60.915	52.47
Taste of pork when roasted	Ordinary	Ordinary	Ordinary
Color of pork	Ordinary	Ordinary	Ordinary
Condition of lard	....	Easily melted	

According to table 2, Experiment I, the pig on molasses and cassava lots lost 7.6 and 7.4 kilos, respectively when not fed for 24 hours while the one on corn-fed lot lost only 3.8 kilos. This showed that the corn-fed pig did not easily lose weight when starved for 24 hours and furthermore it also gave the highest percentage of dressed weight, cassava lot second and molasses lot third.

The molasses-fed lot gave the highest net gain, the cassava fed hog second and the corn-fed hog gave the lowest net gain.

As the color and taste of the pork from the different lots there was no difference noticed except that the lard of the cassava-fed lot melted very easily.

The following table shows the results of the second set of experiment:

TABLE 3.—*Experiment II*

Age of pigs—7 months (Duroc-Poland China) 3 barrows and 3 females.
Experiment begun September 13, 1925, and closed December 12, 1925 (90 days).

	Lot 1	Lot 2	Lot 3
	Molasses, tiqui-tiqui and copra meal	Cassava, tiqui-tiqui and copra meal	Corn, tiqui-tiqui and copra meal
Number of pigs in experiment	2	2	2
Days in experiment	90	90	90
First weight per lot ..... kilos	97.0	104.5	105.5
Final weight per lot ..... do	161.6	172.6	180.4
Total gain per lot ..... do	64.6	68.1	74.9
Average daily gain per pig ..... do	.359	.378	.416
Total tiqui-tiqui consumed ..... kilos	205.77	175.5	195.375
Total copra meal consumed ..... do	61.523	52.65	58.6125
Total corn meal consumed ..... do	.....	.....	58.6125
Total cassava meal consumed ..... do	.....	52.65	.....
Total molasses consumed ..... do	29.00	.....	.....
Total feed consumed of the different kinds ..... do	295.60	280.80	312.60
Total cost of feed consumed of the different kind	₱25.047	₱21.023	₱29.850
Average feed eaten daily per pig ..... kilo	1.642	1.560	1.740
Total feed consumed of the different kinds for 100 kilos gain	457.585	412.334	417.356
Average feed consumed per 1 kilo gain	4.57	4.12	4.47
Total cost of 100 kilos gain	₱38.77	₱30.87	₱39.85
Average daily cost of ration per pig	₱0.139	₱0.116	₱0.165

In this second trial the corn-fed lot gave the highest gain, 74.9 kilos, the cassava-fed lot second, 68.1 kilos, and the molasses-fed lot third, 64.6 kilos. These results were the reverse of the results of the first trial.

Lot 1 consumed the highest amount of feed for 100 kilos gain, lot 3 second, and lot 2 third. The highest cost of gain was made by the corn lot—₱29.85, while the molasses and cassava lots made ₱25.047 and ₱21.023, respectively.

The average daily gain per pig of lots 1, 2, and 3 was 0.359 kilo, 0.387 kilo, and 0.416 kilo, respectively and the average daily cost of the ration per pig is ₱0.139, ₱0.116, and ₱0.165, respectively.

On December 14, 1925, all the pigs used in Experiment II, were butchered and the live and dressed weights were taken. The animals were also deprived of feed for the whole day of December 13, 1925. The value of the pork produced was also estimated at ₱0.80 per kilo.

Flavor, taste and color of pork and condition of lard were also observed.

The following table shows the weight at the end of the experiment, the weight after the pigs were without feed for 24 hours, the per cent of dressed weight, the value of pork produced, the total net profit after deducting the cost of feed and the taste and color of pork and the condition of the lard:

TABLE 4.—*Experiment II*

	Lot 1	Lot 2	Lot 3
	Molasses	Cassava	Corn
	Kilos	*Kilos*	*Kilos*
Weight on December 12, 1925	161.6	172.6	180.4
Weight on December 14, 1925	153.8	164.4	171.4
Decrease in weight	7.8	8.2	9.0
Dressed weight	129.2	134.8	138.8
Per cent dressed weight	84.0	81.99	80.98
Value of pork at ₱0.80 a kilo	₱103.36	₱107.84	₱111.04
Cost of total feed consumed	₱24.047	₱21.023	₱29.85
Net return after deducting cost of feed	₱78.31	₱86.817	₱81.198

According to the above table the pigs on lots 1, 2, and 3 lost 7.8 kilos, 8.2 kilos, and 9 kilos, respectively. These results are again the reverse of the results of the first trial.

The highest percentage of dressed weight was made by lot 1 (84%), the second highest was made by the cassava lot (81.99%) and the smallest was made by the corn-fed lot (80.98%). These results are also the reverse of the first trial.

The cassava-fed lot made the highest net gain (₱86.82) the corn-fed lot (₱81.18) made the second and the molasses-fed lot (₱78.31) made the smallest net gain.

As to the color and taste of pork from the different lots there was no difference noticed. The condition of the lard was observed to be the same.

The following table shows the results of the third trial:

TABLE 5.—*Experiment III*

Experiment begun September 18, 1925, and closed December 17, 1925 (90 days).

	Lot 1 Molasses, tiqui-tiqui, and copra meal	Lot 2 Molasses, tiqui-tiqui, and copra meal	Lot 3 Molasses, tiqui-tiqui, and copra meal
Number of pigs in experiment	1	1	1
Days in experiment	90	90	90
First weight per lot ... kilos	88	100.4	91.6
Final weight per lot ... do	124.2	135.8	126.0
Total gain per lot ... do	36.2	35.4	34.4
Average daily gain per lot ... do	.402	.393	.382
Total tiqui-tiqui consumed ... do	161.69	137.25	149.69
Total copra meal consumed ... do	48.52	41.175	44.907
Total corn meal consumed ... do	....	....	44.907
Total cassava consumed ... do	....	41.175	....
Total molasses consumed ... do	25.00	....	....
Total feed ... do	235.2	219.6	239.50
Total cost of feed consumed	₱19.88	₱16.44	₱22.87
Average feed eaten daily per pig ... kilos	2.615	2.44	2.66
Total feed consumed per 100 kilos gain	649.74	620.33	696.22
Average feed consumed per 1 kilo gain	6.49	6.20	6.96
Total cost of 100 kilos gain	₱54.92	₱45.44	₱66.47
Average cost daily ration per pig	₱0.212	₱0.183	₱0.254

The table shows that the lot 1 fed with a ration of molasses, tiqui-tiqui, and copra meal made the highest gain; the lot 2 fed with a ration of cassava, tiqui-tiqui, and copra meal made the second highest; and the lot 3 fed with a ration of corn meal, tiqui-tiqui, and copra meal made the smallest gain.

Lots 1, 2, and 3 made a total gain during the period of the experiments of 36.2 kilos, 35.4 kilos, and 34.4 kilos, respectively and each lot required 649.74 kilos, 620.33 kilos, and 696.22 kilos, respectively.

The cost per 100 kilos gain in lot 1, 2 and 3 are ₱54.92, ₱46.44 and ₱66.47, respectively.

On December 19, all the pigs in Experiment III were killed and at the same time the live and dressed weights were taken. The animals were also out of feed the whole day of December 18. The value of the pork produced was also estimated at ₱0.80 per kilo.

The taste and color of pork and condition of lard were also observed.

The following table shows the weight at the end of the experiment, the weight after the pigs were without feed for 24 hours, the per cent of dressed weight, the value of pork produced, the total net profit after deducting the cost of feed and the taste, color of pork and the condition of the lard:

TABLE 6.—*Experiment III*

	Lot 1	Lot 2	Lot 3
	Molasses	Cassava	Corn
	Kilos	*Kilos*	*Kilos*
Weight on December 17, 1925	124.2	135.8	126
Weight on December 19, 1925	117.6	129.8	121.2
Weight lost	6.6	6	4.8
Weight (dressed)	98.7	106.9	99.3
Per cent dressed weight	83.93	82.35	81.93
Cost of pork at ₱0.80 per kilo	₱78.96	₱85.52	₱79.44
Total cost of feed consumed	₱19.88	₱16.444	₱22.87
Net return after deducting cost of feed	₱59.08	₱69.078	₱56.57

The table shows that the pigs in lots 1, 2, and 3 lost 6.6 kilos, 6 kilos, and 4.8 kilos, respectively, when not given feed for 24 hours.

The highest per cent of dressed weight (83.93 kilos) was made by lot 1, the second highest (82.35 kilos) was made by lot 2, and the smallest (81.93 kilos) was made by lot 3.

The cassava-fed hog or lot 2 gave the highest net gain ₱69.78, the molasses-fed hog or lot 1 gave ₱59.08 second, the corn-fed hog or lot 3 gave only ₱56.57 the smallest of all.

As to the color and taste of pork from the different lots, no difference was noticed. The condition of lard was almost the same.

Table 7 shows the summary of results of the 3 sets of experiments.

TABLE 7.—*Summary of results*

Experiments and lot number	Average daily gain per pig	Average daily amount of feed consumed per pig	Average daily cost of feed per pig	Average feed consumed per kilo gain	Per cent dressed weight	Net profit after deducting the cost of feed
LOT 1.—*Molasses*						
	Kilos	*Kilos*	*Kilos*	*Kilos*	*Kilos*	*Kilos*
Experiment I	0.674	2.972	0.255	4.41	83.22	68.28
Experiment II	0.359	1.642	0.139	4.57	84.00	78.31
Experiment III	0.402	2.613	0.210	6.49	83.93	59.09
Total	1.435	7.217	0.615	15.47	251.15	205.67
Average	0.478	2.409	0.204	5.09	843.72	68.56
LOT 2.—*Cassava*						
Experiment I	0.570	3.084	0.256	5.41	84.56	60.918
Experiment II	0.378	1.560	0.116	4.12	81.99	86.817
Experiment III	0.393	2.440	0.183	6.20	82.35	69.078
Total	1.341	7.084	0.555	15.73	248.90	216.808
Average	.447	2.361	0.185	5.24	82.96	72.269
LOT 3.—*Corn*						
Experiment I	0.535	3.080	0.287	5.75	85.16	52.44
Experiment II	0.416	1.740	0.165	4.17	80.98	81.19
Experiment III	0.382	2.660	0.254	6.96	81.93	56.570
Total	1.333	7.480	0.706	16.88	248.07	190.200
Average	.444	2.49	0.235	5.62	82.69	63.40

SUMMARY

Taking the averages of the results of the different lots in the 3 sets of experiment, the average daily gain per pig of lot 1, molasses is 0.478; lot 2, .447 cassava; and lot 3, corn is .444. The average daily amount of feed consumed per pig in lot 3 was 2.49 kilos, the highest; lot 1, second 2.409 kilos; and lot 2, the smallest 2.361 kilos.

The corn for lot 3 cost ₱0.235 a day the highest cost of feed consumed per pig. This shows that corn is an expensive feed for fattening hogs here in comparison with the molasses and cassava, which cost ₱0.204 and ₱0.185 respectively.

Lot 3 used an average of 5.62 kilos of feeds to make a kilo of gain, lot 2 used an average of 5.24 kilos and lot 1 used an average of 5.09 kilos each.

The molasses-fed lot gave the highest percentage of dressed weight, the corn-fed lot second, and the cassava-fed lot third.

The cassava-fed lot gave ₱72.269 the highest net gain, the molasses-fed lot ₱68.56 second, and the corn-fed lot ₱63.41 the lowest.

According to these experiments cassava when fed with tiqui-tiqui and copra meal to fatten hogs gives a better net gain than either molasses and corn with tiqui-tiqui and copra meal.

Molasses stands second for the amount of net profit and corn.

It is to be noted in this table that the average daily gain of pigs in Experiment I in all lots 1, 2, and 3 was much higher than those of the pigs in Experiments 2 and 3 also in all lots. This fact may be attributed to the quality of these crossed bred pigs (Duroc-Jersey–Yorkshire-Berkshire) which were more vigorous than the crossed bred pigs used in the other sets of experiments.

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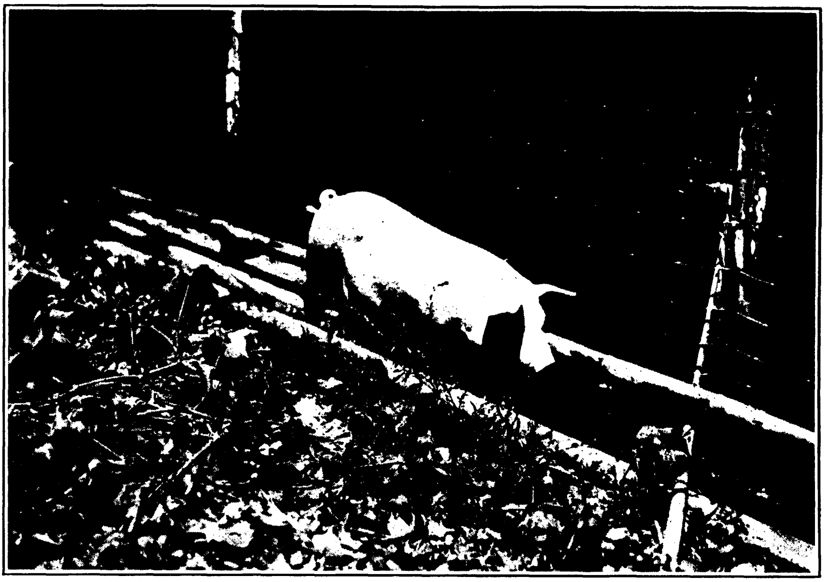
(11) Texas Bulletin No. 131.
(12) Agricultural Experiment Station, College of Agriculture, University of Arkansas: Fattening Swine on Rice and Rice By-Products, Bulletin No. 128.

(*a*) Lot I. Molasses fed. Experiment No. I. Initial weight, 75.0 kilos.

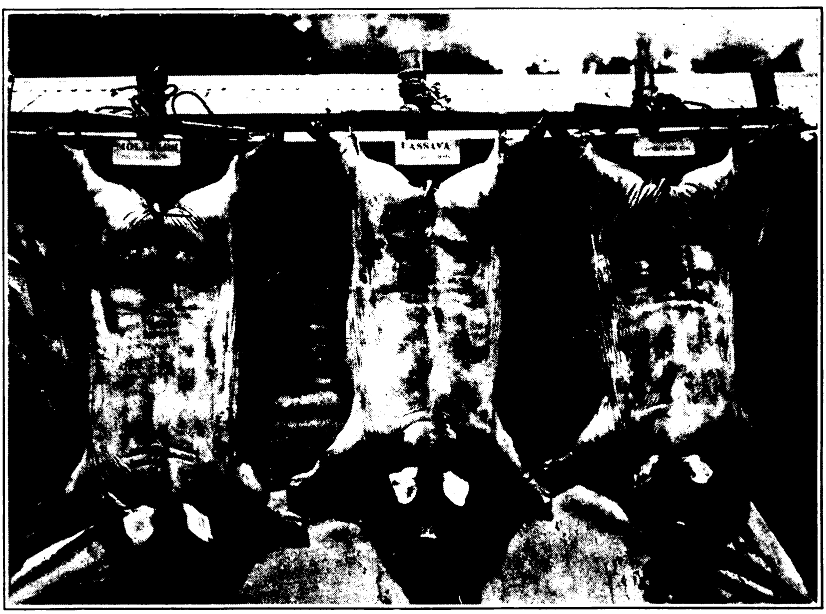
(*b*) Lot II. Cassava fed. Experiment No. I. Initial weight, 74.4 kilos.



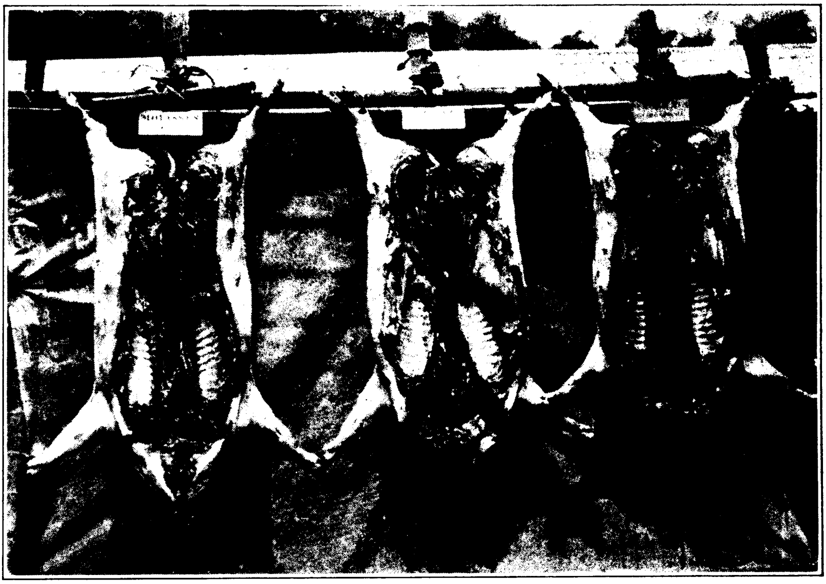
(*a*) Lot III. Corn fed. Experiment No. I. Initial weight, 67.0 kilos.

(*b*) Pigs in Experiment No. 1, after two months. Average weight at start, 72.1 kilos; after two months, 107.7 kilos. Marked according to number of lot.

(*a*) Pigs in Experiment No. 1. After two months. Lying down in the water in one of the pens. Average weight at the start of the experiment, 72.1 kilos; after two months an average of 107.7 kilos.



(*b*) Finished pigs, Experiment No. 1. Average initial weight, 72.1 kilos. Average final weight, 143.93 kilos. Per cent dressed weight—molasses, 83.22%; cassava, 84.56%; and corn, 85.16%.



..(*a*) Finished pigs. Experiment No. 1. Average initial weight, 72.1 kilos. Average final weight, 143.93 kilos. Percent dressed weight—molasses, 83.22%; cassava, 84.56%; and corn, 85.16%.

(*b*) Pigs in experiment No. 2, Lot I. Average weight at the start of the experiment, 48.5 kilos.

(*a*) Pigs in Experiment No. 2, Lot II. Average weight at start of experiment, 52.25 kilos.

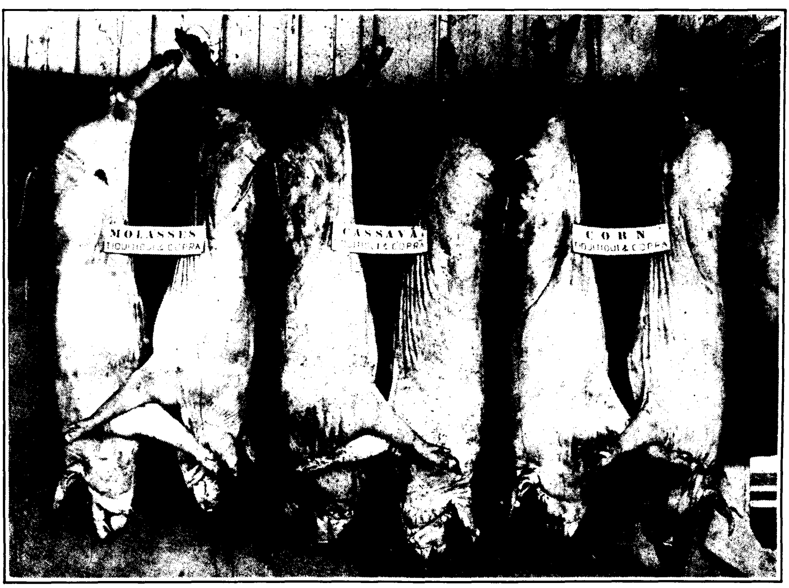
(*b*) Pigs in Experiment No. 2, Lot III. Average weight at start of the experiment, 52.75 kilos.

Pigs in Experiment No. 2. Average initial weight at the start of the experiment, 50.23 kilos.

(*a*) Finished pigs in Experiment No. 2, Lot I. Average weight at start of experiment, 48.5 kilos; at end of experiment, 80.8 kilos.

(*b*) Finished pigs under Experiment No. 2, Lot II. Average weight at start of experiment, 52.25 kilos. Average weight at the end of experiment, 86.3 kilos.

(*a*) Finished pigs in Experiment No. 2, Lot III. Average weight at start of experiment, 52.75 kilos; at end, 60.2 kilos.



(*b*) Finished pigs in Experiment No. 2, Average per cent dressed weight: molasses, 84.0%; cassava, 81.99%; and corn, 80.98%.

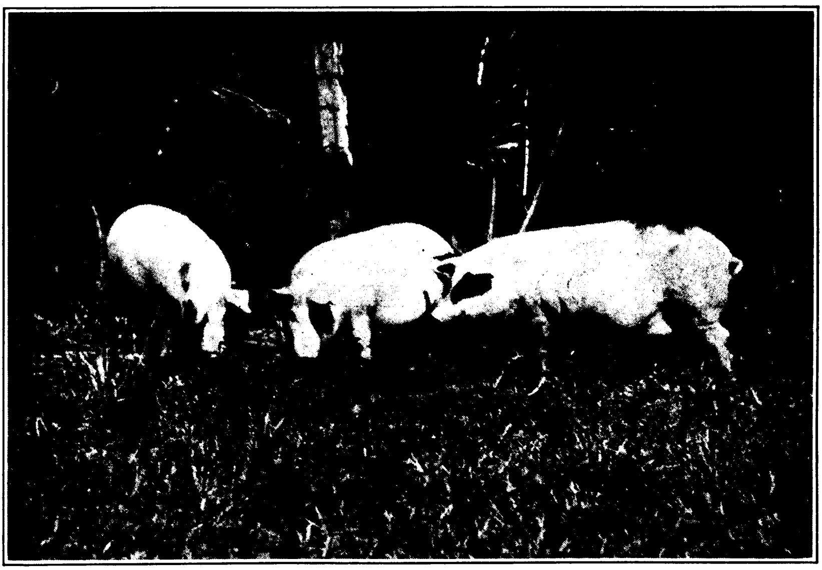
PLATE XL

Finished pigs in Experiment No. 2. Average per cent dressed weight: molasses, 84.0%; cassava, 81.99%; and corn, 80.98%.

(*a*) Pig in Experiment No. 3, Lot I. Initial weight at the start of experiment, 88.0 kilos.

(*b*) Pig in Experiment No. 3, Lot II. Initial weight at start of experiment, 100.4 kilos.

(*a*) Pigs in Experiment No. 3, Lot III. Initial weight at start of experiment, 91.6 kilos.



(*b*) Pigs in Experiment No. 3. Average initial weight at start of experiment, 93.33 kilos.

(*a*) Finished pig in Experiment No. 3, Lot I. Weight at start of experiment, 88.0 kilos; weight at end of experiment, 124.2 kilos. Front view.

(*b*) Finished pigs in Experiment No. 3, Lot I. Weight at start of experiment, 88.0 kilos. Weight at end of experiment, 124.2 kilos. Back view.

(*a*) Finished pig in Experiment No. 3, Lot II. Weight at start of experiment, 104.4 kilos; weight at end, 135.8 kilos. Front view.

(*b*) Finished pig in Experiment No. 3, Lot II. Weight at start of experiment, 104.4 kilos; weight at end of experiment, 135.8 kilos. Back view.

(*a*) Finished pig in Experiment No. 3, Lot III. Weight at start of experiment, 91.6 kilos; weight at end of experiment, 126.0 kilos. Front view.

(*b*) Finished pig in Experiment No. 3, Lot III. Weight at start of experiment, 91.6 kilos; at end, 126.0 kilos. Back view.

(*a*) Finished pigs in Experiment No. 3. Average weight at start of experiment, 93.33 kilos; at end, 128.66 kilos.

(*b*) Finished pigs in Experiment No. 3. Per cent dressed weight: molasses, 83.93%; cassava, 82.35%; and corn, 81.93%. Dorsal view.

(*a*) Finished pigs in Experiment No. 3. Per cent dressed weight: molasses, 83.93%; cassava, 82.35%; and corn, 81.93%. Side view.

(*b*) Finished pigs in Experiment No. 3. Per cent dressed weight: molasses, 83.93%; cassava, 82.35%; and corn, 81.93%. Ventral view.

THE EFFECT OF ADDING MOISTURE TO THE EGG CHAMBER ON THE PERCENTAGE OF EGGS HATCHED UNDER ARTIFICIAL INCUBATION

By EXEQUIEL ALCACID, *Superintendent, Alabang Stock Farm*

It is of economic importance to know the causes of embryo mortality in hatching eggs artificially. Experiments have been performed to determine definitely the factor or factors causing such death. Some of these factors are beyond the power of the person in charge of incubators.

It was once believed that eggs from high-producing hens would hatch as well as those from low-producing hens. H. R. Lewis, (1) in his experiment, found no appreciable difference between the percentage of hatch of eggs from high-producing hens and that of eggs from low-producing hens on both the light and the heavy breeds.

Nai (2) in his work on "Hatching Eggs at Different Seasons of the Year" concluded that eggs hatch better in the months with low temperature than those with high temperature. He also found that it was the tendency for eggs from hens in good condition to hatch better than those laid by hens in poor condition.

The success of incubating eggs artificially depends mostly upon maintaining the proper conditions in the egg chamber.

Some reliable means of controlling moisture conditions which may be properly employed by inexperienced as well as experienced operators are especially important in view of the rapid extension of artificial incubation in the Islands.

Lewis in his work on the subject obtained 50.7 per cent of all eggs set in an incubator without a moisture tray and 65.9 per cent of all eggs set from eggs put in an incubator with a moisture tray.

The West Virginia Experiment Station (3) made a series of observation on the normal loss of weight of eggs during incubation under brooding hens, which showed that the eggs that hatched under hens lost on an average of 16.5 per cent of their weight in nineteen days, while the infertile eggs and those which did not hatch lost from 1 to 2 per cent less. The normal loss of 100 eggs was found to be about 10 ounces in six days, 20 ounces in 12 days, and 31 ounces in 18 days.

The cause of poor hatches depends on many circumstances. This may be due to the age of the setting eggs as it was found

out at the Alabang Stock Farm (4) that new laid eggs gave a higher percentage of hatch than eggs more than a week old. It might also be due to setting eggs from weak or improperly cared for breeding stock. Or it may be due to lack of proper care during incubation.

The work reported here is an experiment on *artificially added moisture* to eggs under artificial incubation. Different methods of supplying moisture were employed to find out the advantage or disadvantage of such application in hatching eggs. The loss of moisture by evaporation from eggs during the period of incubation was also determined. Observations were made on the size, weight, and vigor of chicks hatched in the different sets.

The object of this experiment was to determine the effect on the percentage of hatch of eggs of adding moisture to the egg chamber of an incubator and to compare the loss of moisture from eggs by evaporation.

This experiment was begun on May 5, 1925, and ended January 7, 1926, and was performed at the Alabang Stock Farm, Muntinlupa, Rizal, P. I.

To determine the moisture in each set, the eggs were weighed at the beginning of the experiment and weekly thereafter.

The eggs used were laid by different breeds if chickens raised in the farm. In each trial the eggs incubated were about the same age at the time they were put in the incubator.

The incubators used were of the same type—Buckeye—with a capacity of about 120 eggs each. One incubator was used as check, that is, the eggs incubated in this incubator did not receive any artificially supplied moisture. In another incubator the eggs were sprinkled with lukewarm water every morning at the time of cooling. The artificial supply of moisture was begun after the first week of incubation. The nursery tray of the third incubator was provided with sun dried sand which was kept moist all the time. The supply of moisture here was also begun after the first week of incubation. The amount of water artificially supplied were measured to determine the amount added during the whole period of incubation.

It is unfortunate that for lack of a sufficient number of eggs to fill the three incubators they could not be run at the same time. However this would not probably, nor did greatly, affect the desired results as the intervals between each set was only 1 day or 2 days and at most a week.

The results may be seen in the following tables:

TRIAL No. I

Set No. 1.—Check

TABLE 1.—*Results on incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs, first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
BmBmBn	32	15	46.87	1	3.12	2	6.25	4	12.50	10	31.25	58.82	These eggs were set May 6, 1925.
WLBocWLCant	22	4	18.18	1	4.55	1	4.55	5	22.72	11	50.00	61.11	
BrLBocg	24	6	25.00	2	8.33	2	8.33	9	37.50	5	20.83	27.77	
Boc ⅞	47	5	10.63	1	2.13	4	8.52	13	27.68	24	51.04	57.14	
Total	125	30	24.00	5	4.00	9	7.20	31	24.80	50	40.00	52.63	

NOTE:

BmBmBn	=	¾ Black Minorca ¼ Black Native
WLBOC-WLCant	=	½ White Leghorn ⅜ Cantonese ⅛ Buff Orpington
BrLBOCg	=	½ Brown Leghorn ¼ Buff Orpington ¼ Cantonese
BOC ⅞	=	⅞ Buff Orpington ⅛ Cantonese
BMBN ⅞	=	⅞ Black Minorca ⅛ Black Native
WLBOC	=	½ White Leghorn ¼ Buff Orpington ¼ Cantonese
(WLBOC)2WLC	=	½ White Leghorn ⅜ Cantonese ⅛ Cantonese
WLBOCg	=	½ White Leghorn ¼ Buff Orpington ¼ Cantonese
BOC 15/16	=	15/16 Buff Orpington 1/16 Cantonese

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
BmBmBn	52.30	50.30	2.00	47.99	2.31	46.50	1.49	These eggs were laid on May 2, 1925 and were set when 4 days old. Weight in grams.
WLBocWLCant	44.82	43.20	1.62	41.95	1.25	40.90	1.05	
BrLBocg	47.61	46.90	.71	....	....	....	....	
Boc ⅞	46.08	43.60	2.48	41.10	2.50	39.40	1.70	
Total	....	....	6.81	....	6.06	....	4.24	
Average	....	....	1.70	....	2.02	....	1.41	

NOTE.—All weights measured in grams.

TRIAL No. I—Continued

Set No. 1.—Check—Continued

TABLE 1.—*Results of incubation tests*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

Breeds	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
BmBmBn	51.25	49.20	2.05	47.00	2.20	45.50	1.50	These eggs were laid on May 3, 1925 and were set when 3 days old.
WLBocWLCant.	56.30	53.50	2.80	51.07	2.43	50.10	1.97	
BrLBocg	56.30	54.20	2.10	52.40	1.80	50.80	1.60	
Boc 7/8	52.30	49.60	2.70	48.35	1.25	....	....	
Total	....	....	9.65	....	7.68	....	5.07	
Average	....	....	2.41	....	1.92	....	1.69	
BmBmBn	51.00	48.75	2.25	46.95	1.80	45.20	1.75	These eggs were laid on May 4, 1925 and were set when 2 days old.
WLBocWLCant.	44.38	42.80	1.58	....	....	....	....	
BrLBocg	....	....	....	....	....	....	....	
Boc 7/8	51.02	48.45	2.57	46.20	2.25	44.30	1.90	
Total	....	....	6.40	....	4.05	....	3.65	
Average	....	....	2.13	....	2.03	....	1.83	
BmBmBn	45.85	43.95	1.90	....	....	....	....	These eggs were laid on May 5, 1925 and were set when 1 day old.
WLBocWLC	60.21	57.80	2.41	55.55	1.25	53.80	1.75	
BrLBocg	50.49	48.20	2.29	46.55	1.65	44 70	1.85	
Boc 7/8	53.50	50.60	2.90	47.50	3.10	45.60	1.90	
Total	....	....	9.50	....	6.00	....	5.50	
Average	....	....	2.38	....	2.00	....	1.83	

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs when set	7th day	14th day	19th day	Grand total	
4 days old	1.70	2.02	1.41	5.13	The eggs were set on May 6, 1925.
3 days old	2.41	1.92	1.69	6.02	
2 days old	2.13	2.02	1.83	5.99	
1 day old	2.38	2.00	1.83	6.21	
Total	8.62	7.97	6.76		
Average	2.16	1.99	1.69	5.84	
Average incubator temperature	102°F	103°F	104°F	309 = 103°F	
Average room temperature	88°F	88°F	87°F	261 = 87°F	

NOTE.—All weights measured in grams.

Set No. 2.—Eggs were sprinkled with lukewarm water from the 8th day of incubation

TABLE 2.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs, first week		Dead germs, second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
Boc 7/8	48	10	20.83	0	00.00	5	10.41	14	29.16	19	39.58	50.00	These eggs were set on May 5, 1925.
WLBoc	16	8	50.00	0	00.00	2	12.50	0	00.00	6	37.50	75.00	
BrLCant.	13	10	76.92	0	00.00	2	14.38	0	00.00	1	7.69	33.33	
BmBmBn.	5	0	00.00	0	00.00	1	20.00	2	40.00	2	40.00	40.00	
BrLBocg.	11	2	18.18	0	00.00	0	00.00	2	18.18	7	63.64	77.77	
WLBocWLcant	14	3	21.43	0	00.00	2	14.29	4	28.58	5	35.71	45.45	
BmBn	4	1	25.00	0	00.00	1	25.00	1	25.00	1	25.00	33.33	
Boc 15/16	4	0	00.00	0	00.00	0	00.00	0	00.00	4	100.00	100.00	
WLCantWLBoc	6	0	00.00	0	00.00	0	00.00	2	33.33	4	66.67	66.67	
Total	121	34	28.10	0	00.00	13	10.74	25	20.66	49	40.50	56.32	

TRIAL No. I—Continued

Set No. 2.—**Eggs were sprinkled with lukewarm water from the 8th day to 18th day of incubation—Continued**

TABLE 2.—*Results of incubation tests*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Boc $\frac{7}{8}$	45.30	44.30	1.00	42.65	1.65	41.80	0.85	The eggs were laid on May 2, 1925 and set when 3 days old. The weight is in gram.
WLBoc	45.90	45.10	0.80					
BrLCant								
BmBmBn	45.60	44.30	1.30	42.84	1.46			
BrLBocg	50.40	49.40	1.00	47.70	1.70	46.90	0.80	
WLCocWLCant	45.00	44.50	0.50					
BmBn	34.60	33.15	1.45	31.60	1.55	30.80	0.80	
Boc 15/16	44.80	43.80	1.00	42.45	1.35	41.50	0.95	
WLCantWLBoc	46.70	45.60	1.10	44.00	1.60	42.90	1.10	
Total			8.15		9.31		4.50	
Average			1.02		1.55		0.90	
Boc $\frac{7}{8}$	42.30	38.40	3.90					These eggs were laid on May 3, 1925 and set when 2 days old.
WLBoc	43.30	42.40	0.90					
BrLCant								
BmBmBn	47.80	46.70	1.10	45.30	1.40	44.07	1.23	
BrLBocg	46.60	45.82	0.78	44.60	1.22	43.80	0.80	
WLBocWLCant	44.45	42.90	1.55	40.70	2.20	39.50	1.20	
BmBn	34.50	33.30	1.20	32.10	1.20	31.05	0.05	
Boc 15/16	44.65	43.90	0.75	42.74	1.16	41.65	1.09	
WLCantWLBoc	44.30	43.60	0.70	42.35	1.25	41.55	0.80	
Total			10.88		8.43		5.17	
Average			1.36		1.41		0.86	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

Boc 7/8	41.00	39.40	1.60	37.42	1.98	36.15	1.27	
WLBoc	46.10	45.20	0.90					
BrLCant								
BmBmBn	49.30	48.40	0.90	47.05	1.35	46.10	0.75	These eggs were laid May 4, 1925 and set when 1 day old.
BrLBocg	40.20	39.40	0.80					
WLBocWLCant	48.35	47.80	0.55					
BmBn	34.00	33.30	0.70					
Boc 15/16	46.60	45.72	0.88	44.40	2.20	43.54	0.86	
WLCant WLBoc	41.00	40.10	0.90	36.30	4.70	34.49	1.81	
Total			7.23		10.23		4.69	
Average			0.90		2.56		1.17	

C. TOTAL AMOUNT OF MOISTURE LOST

Age of egg when set	7th day	14th day	19th day	Grand total	Remarks
3 days old	10.02	1.55	0.90	3.47	
2 days old	1.36	1.41	0.86	3.63	
1 day old	0.90	2.56	1.17	4.63	
Total	3.28	5.52	2.93		
Average	1.09	1.09	1.84	3.91	
Average incubator temperature	102°F	102°F	104°F	308°F = 103°F	
Average room temperature	86°F	87°F	87°F	260°F = 87°F	
Amount of water sprinkled	1,020 cc	520 cc	1,540 cc		

NOTE.—All weights measured in grams.

TRIAL No. I —Continued

Set No. 3.—Sand kept wet with water from the 8th day until end of incubation

TABLE 3.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs, first week		Dead germs, second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
Boc ⅞	16	1	6.25	.00	00.00	3	18.75	3	18.75	9	56.25	60.00	These eggs were set May 14, 1925.
BmBmBn	9	3	33.33	.00	00.00	....	....	1	11.11	5	55.56	83.33	
Br. L. Cant	12	3	25.00	.00	00.00	2	16.67	0	....	7	58.33	77.77	
Br. L. Boc	16	1	6.25	1	6.25	2	12.50	2	12.50	10	62.50	66.66	
WLC-WLBOC	12	3	25.00	0	0.00	1	8.34	1	8.34	7	58.33	77.77	
WLBoc-WLC	8	2	25.00	0	0.00	....	....	1	12.50	5	62.50	83.33	
WL-Boc	12	3	25.00	0	0.00	....	....	....	....	9	75.00	100.00	
Bm-Bn	9	8	88.89	0	0.00	....	....	1	11.11	0	00.00	00.00	
Expt	23	2	8.69	1	4.35	....	....	3	....	17	73.91	80.95	
Boc 15/16	3	0	0.00	0	0.00	....	....	0	....	3	100.00	100.00	
Total	120	26	21.67	2	1.67	8	6.67	12	10.00	72	60.00	76.60	

B. LOSS OF MOISTURE EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Boc ⅞	50.80	48.00	2.80	46.70	1.30	....	....	These eggs were laid on May 9, 1925 and set when 5 days old.
BmBmBn	54.10	52.00	2.10	50.60	1.40	49.40	1.20	
Br. L. Cant	38.70	37.10	1.60	36.00	1.10	35.20	0.80	
Br. L. Bocg	47.80	46.00	1.80	44.85	1.15	43.90	0.95	
WLC-WLBoc	39.60	37.80	1.80	....	....	....	....	
WLBoc-WLC	51.60	49.90	1.70	48.45	0.45	47.40	1.05	
WLBoc	48.80	46.90	1.90	45.50	1.40	44.40	1.10	
BmBn	30.00	28.70	1.30	....	....	....	....	
Expt	44.20	42.50	1.70	....	....	....	....	
Boc 15/16	42.90	41.30	1.60	40.4	0.90	39.30	1.10	
Total	....	....	18.30	....	7.70	....	6.20	
Average	....	....	1.83	....	1.10	....	1.03	

B. LOSS OF MOISTURE EGGS UNDER INCUBATION—Continued

Boc $\frac{7}{8}$	50.50	49.00	1.50	47.70	1.30	46.30	1.40	
BmBmBn	48.80	46.90	1.90	45.60	1.30	44.60	1.00	
Br. L. Cant.	39.90	38.60	1.30					
Br. L. Bocg.	44.90	43.50	1.40	42.70	0.70	42.00	0.70	
WLC–WLBoc.	44.40	43.00	1.40	41.80	1.20	40.60	1.20	These eggs were laid May 10, 1925 and set when 4 days old.
WLBoc–WLC.	45.70	43.80	1.90	42.50	1.30	41.20	1.30	
WLBoc.	43.70	42.00	1.70	40.65	1.35	39.80	0.85	
BmBn.	29.40	27.50	1.90					
Expt.	42.60	41.05	1.55	39.90	1.15	38.80	1.10	
Boc 15/16	42.30	40.70	1.60	39.60	1.10	38.80	0.80	
Total			16.15		9.40		8.35	
Average			1.615		1.18		1.04	
Boc $\frac{7}{8}$	47.00	44.60	2.40	42.40	2.40	41.90	0.30	
BmBmBn	49.10	47.60	1.50					
Br. L. Cant.	39.40	38.20	1.20					
Br. L. Bocg.	46.70	45.10	1.60	44.30	0.80			
WLC–WLBoc.	46.70	45.00	1.70	43.40	1.60	41.90	1.50	These eggs were laid May 11, 1925 and set when 3 days old.
WLBoc–WLC.	45.20	44.20	1.00					
WLBoc.	38.80	37.40	1.40	36.30	1.10	35.70	0.60	
BmBn.	42.90	41.70	1.20					
Expt.	47.50	46.50	1.00					
Boc 15/16	42.30	40.80	1.50	39.70	1.10	38.80	0.90	
Total			14.50		7.00		3.30	
Average			1.45		1.40		0.83	
Boc $\frac{7}{8}$	49.10	46.45	2.65	45.00	1.45	43.70	1.30	
BmBmBn	52.20	50.10	1.90	48.70	1.40	47.60	1.10	
Br. L. Cant.	39.60	37.80	1.80	36.70	1.10	35.70	1.00	
Br. L. Bocg.	51.10	39.80	1.30					
WLC–WLBoc.	41.90	41.30	0.60					These eggs were laid May 12, 1925 and set when 2 days old.
WLBoc–WLC.	56.70	55.70	1.00					
WLBoc.	43.40	41.60	1.80	40.15	1.45	38.80	1.35	
BmBn.	43.90	42.70	1.20					
Expt.	45.30	43.40	1.90					
Boc 15/16	42.40	41.40	1.00					
Total			15.15		5.40		4.75	
Average			1.515		1.35		1.19	

NOTE.—All weights measured in grams.

Set No. 3.—**Sand kept wet with water from the 8th day until end of incubation—Continued**

TABLE 3.—*Results of incubation tests*—Continued

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs when set	7th day	14th day	19th day	Grand total	Remarks
2 days old	1.515	1.35	1.19	4.055	
3 days old	1.450	1.40	0.83	3.68	
4 days old	1.615	1.18	1.04	3.835	
5 days old	1.880	1.10	1.03	3.96	
Total	6.41	5.03	4.09		
Average	1.60	1.26	1.02	3.88	
Average incubator temperature	102°F	103°F	103°F	308°F = 103°F	
Average room temperature	86°F	87°F	87°F	260°F = 87°F	
Amount of moisture added to dry sand				860 cc.	

TRIAL No. II

Set No. 1.—**Check—No water added from beginning to end of incubation—Continued**

TABLE 4.—*Results on incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs, first week		Dead germs, second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
R. I. Red	46	7	15.22	0	00.00	5	10.87	11	23.91	23	50.00	58.97	These eggs were set on the morning of June 17, 1925.
Br. Leghron	9	5	55.56	0	00.00	2	22.22	1	11.11	1	11.11	25.00	
W. Leghorn	28	11	39.29	1	3.57	2	7.14	3	10.71	11	39.29	64.71	
Buff. Orpt.	6	0	00.00	0	0.00	0	0.00	0	0.00	6	100.00	100.00	
B. P. Rock	23	5	21.74	0	0.00	1	4.35	8	34.78	9	39.13	50.00	
Total	112	28	25.00	1	0.89	10	8.93	23	20.54	50	44.64	59.52	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weigth at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
R. I. Red	50.80	49.40	1.40	47.60	1.80	46.30	1.30	These eggs were laid on June 13, 1925 and set at 4 days of age.
Br. Leghorn	60.20	58.15	2.05	....	....	....	....	
W. Leghorn	61.44	59.75	1.69	57.60	2.15	56.10	1.50	
Buff. Orpt	49.85	47.85	2.00	45.10	2.75	43.75	1.35	
B. P. Rock	54.00	52.35	1.65	50.10	2.25	48.60	1.40	
Total	....	....	8.79	....	8.95	....	5.55	
Average	....	....	1.76	....	2.24	....	1.39	
R. I. Red	55.50	53.89	1.61	51.20	2.69	50.00	1.20	These eggs were laid on June 13, 1925 and set when 3 days old.
Br. Leghorn	55.55	54.40	1.15	....	....	....	....	
W. Leghorn	50.70	50.05	0.65	47.50	4.55	45.90	1.60	
Buff. Orpt	46.60	44.70	1.90	41.95	2.75	40.10	1.85	
B. P. Rock	52.56	52.25	0.31	50.30	1.95	49.00	1.30	
Total	....	....	5.62	....	11.94	....	5.95	
Average	....	....	1.12	....	2.99	....	1.49	
R. I. Red	63.90	62.00	1.90	59.10	2.90	....	....	These eggs were laid on June 14, 1925 and set when 2 days old.
Br. Leghorn	52.20	51.20	1.00	49.50	1.70	....	....	
W. Leghorn	55.29	52.50	2.79	....	....	....	....	
Buff. Orpt	48.62	46.75	1.87	44.10	2.65	42.70	1.40	
B. P. Rock	54.60	52.42	2.18	50.70	1.72	49.30	1.40	
Total	....	....	9.74	....	8.97	....	2.80	
Average	....	....	1.95	....	2.24	....	1.40	

NOTE.—All weights measured in grams.

TRIAL No. II—Continued

TABLE 4.—*Results of incubation tests*—Continued

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs when set	7th day	14th day	19th day	Grand total	Remarks
4 days old	1.76	2.24	1.39	5.39	
3 days old	1.12	2.99	1.49	5.60	
2 days old	1.95	2.24	1.40	5.59	
Total	4.83	7.47	4.28	....	
Average	1.61	2.49	1.43	5.53	
Average incubation temperature	102°F	102°F	103°F	307°F = 102°F	
Average temperature of incubator cellar	87°F	85°F	86°F	258°F = 86°F	

Set No. 2.—**Eggs sprinkled with lukewarm water every day beginning from the 8th day to 18th day**

TABLE 5.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs, first week		Dead germs, second week		Number died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
B. P. Rock	20	3	15.00	0	00.00	0	00.00	4	20.00	13	65.00	76.47	These eggs were set June 29, 1925.
Buff. Orpt	4	4	100.00	0	00.00	0	00.00	0	00.00	0	00.00	00.00	
W. Leghorn	13	4	30.77	0	00.00	1	7.69	1	7.69	7	53.85	77.77	
Br. Leghorn	2	0	00.00	1	50.00	0	00.00	0	00.00	1	50.00	50.00	
R. I. Red	44	8	18.18	3	6.82	3	16.82	7	15.91	23	52.27	63.88	
Lt. Brahma	5	1	20.00	0	00.00	0	00.00	2	00.00	2	40.00	50.00	
Total	88	20	22.72	4	4.55	4	14.55	14	15.91	46	52.27	67.65	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
B. P. Rock	47.85	46.40	1.45	45.20	1.20	44.20	1.00	These eggs were laid on June 25, 1925, and set when 4 days old.
Buff. Orpt.	50.40	49.00	1.40					
W. Leghorn								
Br. Leghorn	55.50	53.90	1.60					
R. I. Red	57.60	56.30	1.30	54.40	1.90	53.35	1.05	
Lt. Brahma								
Total			5.75		3.10		2.05	
Average			1.44		1.55		1.03	
B. P. Rock	46.80	44.70	2.10	42.00	2.70	40.50	1.50	These eggs were laid on June 26, 1925, and set when 3 days old.
Buff. Orpt.								
W. Leghorn	54.50	53.00	1.50	51 55	1.45	50.40	1.15	
Br. Leghorn								
R. I. Red	56.20	54.70	1.50					
Lt. Brahma	51.70	49.70	2.00	47.50	2.20	45.90	1.60	
Total			7.10		6.35		4.25	
Average			1.78		2.12		1.42	
B. P. Rock	54.10	52.30	1.80	50.30	2.00	49.00	1.30	These egg were laid on June 27, 1925 and set at the age of 2 days.
Buff. Orpt.	49.50	47.70	1.80					
W. Leghorn	66.10	64.40	1.70	62.70	1.70	52.80	1.30	
Br. Leghorn	58.10	56.20	2.10	54.10	2.10	49.70	1.10	
R. I. Red	54.40	52.70	1.70	50.80	1.90			
Lt. Brahma	56.50	54.60	1.90					
Total			11.00		7.70		3.70	
Average			1.83		1.93		1.23	

NOTE.—All weights measured in grams.

TRIAL No. II—Continued

Set No. 2.—**Eggs sprinkled with lukewarm water every day beginning from the 8th day to 18th day—Continued**

TABLE 5.—*Results of incubation tests*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
B. P. Rock	56.05	54.20	1.15	52.25	1.95	51.00	1.25	These eggs were laid on June 28, 1925 and set at the age of 1 day.
Buff Orpt.	50.00	48.30	1.70	....	....	....	....	
W. Leghorn	51.90	50.10	0.80	48.30	1.80	47.00	1.30	
R. I. Red	60.20	58.40	1.80	56.80	1.60	....	....	
Lt. Brahma	53.20	51.30	1.90	49.10	2.20	47.90	1.20	
Total	....	....	7.35	....	7.55	....	3.75	
Average	....	....	1.47	....	1.89	....	1.25	

C. TOTAL AMOUNT OF MOISTURE LOST.

Age of eggs when set	7th day	14th day	19th day	Grand total	Remarks
4 days old	1.44	1.55	1.03	4.02	
3 days old	1.78	2.12	1.42	5.32	
2 days old	1.83	1.93	1.23	4.99	
1 day old	1.47	1.89	1.25	4.61	
Total	6.52	7.49	4.93	....	
Average	1.63	1.87	1.23	4.54	
Average incubation temperature	102°F	102°F	103°F	307°F = 102°F	
Average temperature of incubator cellar	87°F	85°F	85°F	257°F = 86°F	
Total amount of moisture sprinkled	....	....	....	3,640 cc.	

***Set No. 3.*—Sand moist with water from the 8th day to the end of incubation**

TABLE 6.—*Results on incubation*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breeds	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Percent of all eggs	Percent of fertile eggs	
B. P. Rock	39	7	17.94	2	5.13	2	5.13	4	10.26	24	61.54	75.00	These were set June 25, 1925.
W. Leghorn	55	14	25.45	0	00.00	6	11.00	8	14.55	27	49.00	65.85	
Br. Leghorn	7	2	28.57	1	14.29	1	14.29	2	28.57	1	14.29	20.00	
R. I. Red	20	0	00.00	1	5.00	4	20.00	3	15.00	12	60.00	60.00	
Total	121	23	19.01	4	3.31	13	10.74	17	14.05	64	52.89	65.31	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
B. P. Rock	48.40	47.20	1.20					These eggs were laid on June 20, 1925 and set when 5 days old.
W. Leghorn	55.90	54.40	1.50	52.80	1.60			
Br. Leghorn	56.15	55.15	1.00					
R. I. Red	60.00	58.30	1.70	56.60	1.70	55.20	1.4	
Total			5.40		3.30		1.4	
Average			1.35		1.65		1.4	
B. P. Rock	57.15	55.5	1.65	53.70	1.80	52.60	1.05	These eggs were laid on June 21, 1925 and set when 4 days old.
W. Leghorn	46.95	45.5	1.45	44.10	1.40	43.10	1.00	
Br. Leghorn	59.00	57.6	1.40	56.00	1.60	54.80	1.20	
R. I. Red	51.10	49.6	1.50	48.20	1.40	47.05	1.15	
Total			6.00		6.20		4.40	
Average			1.50		1.55		1.10	

NOTE.—All weights measured in grams.

TRIAL No. II—Continued

Set No. 3.—Sand kept moist with water from the 8th day to the end of incubation—Continued

TABLE 6.—*Results on incubation*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 19th day	Loss	Weight on the 19th day	Loss	Remarks
B. P. Rock	52.60	51.30	1.30	50.10	1.20	48.90	1.20	These eggs were laid on June 22, 1925 and set when 3 days old.
W. Leghorn	54.10	52.90	1.20					
Br. Leghorn	58.00	56.70	1.30	55.60	1.10			
R. I. Red	60.00	58.60	1.40					
Total			5.20		2.30		1.20	
Average			1.30		1.15		1.20	
B. P. Rock	56.25	54.70	1.55	53.20	1.50	51.9	1.30	These eggs were laid on June 23, 1925 and set when 2 days old.
W. Leghorn	51.40	49.90	1.50	48.30	1.60	47.0	1.30	
Br. Leghorn	60.10	58.90	1.20					
R. I. Red	41.60	40.00	1.60	38.40	1.60	37.10	1.30	
Total			5.85		4.70		3.90	
Average			1.46		1.57		1.30	

C. TOTAL AMOUNT OF MOISTURE LOST.

Age of eggs	7th day	14th day	19th day	Grand total	Remarks
5 days old	1.35	1.65	1.40	4.40	
4 days old	1.50	1.55	1.10	4.15	
3 days old	1.30	1.15	1.20	3.65	
2 days old	1.46	1.57	1.30	4.33	
Total	5.61	5.92	5.00		
Average	1.40	1.48	1.25	4.13	
Average incubator temprature	101°F	103°F	104°F	308°F = 103°F	
Average temperature of incubator cellar	86°F	85°F	84°F	255°F = 85°F	
Amount of moisture added to sun dried sand				1,840 cc.	

TRIAL NO. III

Set No. 1.—Check—No water added from beginning to end of incubation

TABLE 7.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Percent of all eggs	Percent of fertile eggs	
Br. Leg Bocg	31	8	25.80	5	16.13	3	9.68	3	9.68	12	38.71	52.17	These eggs were set August 13, 1925.
BmBmBn	29	13	44.82	4	13.79	0	0.00	5	17.24	7	24.14	43.75	
Boc $\frac{7}{8}$	31	4	12.90	0	00.00	5	16.13	1	3.23	21	67.74	77.77	
Boc $\frac{3}{4}$	10	0	00.00	1	10.00	0	0.00	0	0.00	9	90.00	90.00	
WLBocWLCant	13	3	23.07	2	15.38	1	7.69	0	0.00	7	52.83	70.00	
(WLBoc) 2 WLC	4	0	00.00	1	25.00	0	0.00	1	25.00	2	50.00	50.00	
Total	118	28	23.73	13	11.02	9	7.63	10	8.47	58	49.15	64.44	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Br. Leg. Bocg	52.45	50.00	1.85	48.78	1.82	46.10	2.68	These eggs were laid August 8, 1925 and set when 5 days old.
BmBmBn	50.10	48.50	1.60	47.10	1.40	45.20	1.90	
Boc $\frac{7}{8}$	54.90	53.00	1.90	....	....	....	....	
Boc $\frac{3}{4}$	49.00	47.60	1.40	46.20	1.40	44.40	1.80	
WLBocWLCant	50.30	48.70	1.60	47.62	1.08	....	....	
Total	....	....	8.35	....	5.70	....	6.38	
Average	....	....	1.67	....	1.43	....	2.13	

NOTE.—All weights measured in grams.

TRIAL No. III—Continued

Set No. 1.—Check—No water was added from the start to end of incubation—Continued

TABLE 7.—*Results of incubation tests*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

Breeds	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Br. Leg. Bocg.	50.00	48.20	1.80	....	....	....	....	These eggs were laid August 9, 1925 and set when 4 days old.
BmBmBn	50.70	49.30	1.40	47.80	1.50	46.00	1.80	
Boc 7/8	43.90	42.70	1.20	41.80	1.90	40.30	1.50	
Boc 3/4	48 70	47.30	1.40	45.10	2.20	44.40	0.70	
WLBocWLCant.	46.00	44.40	1.60	41.60	2.80	40.60	1.00	
Total	....	....	7.40	....	8.40	....	5.00	
Average	....	....	1.48	....	2.20	....	1.25	
Br. Leg. Bocg.	52.60	50.80	1.80	48.00	2.80	46.30	1.70	These eggs were laid August 10, 1925 and set when 3 days old.
BmBmBn	51.90	50.40	1.50	48.76	1.64	47.55	1.21	
Boc 7/8	49.90	47.90	2.00	44.85	3.05	42.10	2.75	
Boc 3/4	50.30	48.60	1.70	46.85	1.75	45.40	1.45	
WLBocWLCant.	45.00	43.90	1.10	41.20	2.70	39.90	1.30	
Total	....	....	8.10	....	11.94	....	8.41	
Average	....	....	1.62	....	2.39	....	1.68	
Br. Leg Bocg.	52.50	51.10	1.40	49.60	1.80	47.30	2.30	These eggs were laid August 11, 1925 and set when 2 days old.
BmBmBn	48.20	46.60	1.60	45.20	1.40	43.30	1.90	
Boc 7/8	50.20	48.00	2.20	46.00	2.00	45.10	0.90	
Boc 3/4	48.10	46.75	1.35	45.20	1.55	43.10	2.10	
WLBocWLCant.	45.40	43.20	2.20	41.40	1.80	39.10	2.30	
Total	....	....	8.75	....	8.55	....	9.50	
Average	....	....	1.75	....	1.71	....	1.90	

C. AMOUNT OF MOISTURE LOST

Age of eggs	7th day	14th day	19th day	Grand total	Remarks
5 days old	1.67	1.43	2.13	5.23	
4 days old	1.48	2.20	1.25	4.93	
3 days old	1.62	2.39	1.68	5.69	
2 days old	1.75	1.71	1.90	5.36	
Total	6.52	7.73	6.96	....	
Average	1.63	1.93	1.69	5.25	
Average incubator temperature	101°F	102°F	104°F	307°F = 102°F	
Average temperature of incubator cellar	84°F	82°F	83°F	244°F = 83°F	

NOTE.—All weights measured in grams.

Set No. 2.—Eggs sprinkled with lukewarm water from the 8th day to 18th day of incubation

TABLE 8.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
Cantonese	41	6	14.63	0	00.00	4	9.76	6	14.63	25	60.98	71.42	These eggs were set August 25, 1925.
Boc ¾	13	2	15.38	0	00.00	2	14.35	1	7.69	8	61.62	80.00	
Boc 15/16	6	5	83.33	0	00.00	0	00.00	1	16.67	0	00.00	00.00	
BmBmBn	21	8	38.09	1	4.76	1	4.76	3	14.28	8	38.08	61.53	
Boc ⅞	8	6	75.00	0	00.00	1	12.50	1	12.50	0	00.00	00.00	
WLBoc 2 WLC	6	0	00.00	0	00.00	0	00,00	0	00.00	6	100.00	100.00	
WLBocWLCant	12	5	41.66	0	00.00	0	00.00	0	00.00	7	58.30	100.00	
Total	107	32	29.92	1	0.93	8	7.48	12	11.21	54	50.47	72.00	

TRIAL No. III—Continued

Set No. 2.—Eggs sprinkled with lukewarm water from the 8th day to 18th day of incubation—Continued

TABLE 8.—*Results of incubation tests*—Continued

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
WLBocWLCant.	50.00	48.65	1.35	46.95	1.70	45.90	1.05	These eggs were laid August 20, 1925 and set when 5 days old.
(WLBoc) 2 WLC.	50.75	49.40	1.35	47.75	1.65	46.80	0.95	
Boc ¾	43.62	41.90	1.72	39.80	2.10	38.50	1.30	
Boc 15/16	44.22	43.10	1.12					
Cant.	43.75	41.90	1.85					
BmBmBn.	46.10	44.60	1.50					
Total			8.89		5.45		3.30	
Average			1.48		1.82		1.10	
WLBocWLCant.	39.30	38.62	0.68	37.65	0.97	36.00	0.75	These eggs were laid August 21, 1925 and set when 4 days old.
(WLBoc)2 WLC.	48.00	47.25	1.35	45.65	1.60	44.60	0.95	
Boc ¾	48.92	47.55	1.37	46.05	1.50	45.20	0.85	
Boc 15/16	48.90	47.10	1.80					
Cant.	41.45	39.72	1.73	37.90	1.82	36.70	0.80	
BmBmBn.	42.08	40.10	1.98					
Total			8.91		5.89		3.35	
Average			1.49		1.47		0.84	
WLBocWLCant.	44.35	43.70	0.65	41.70	2.00	40.70	1.00	These eggs were laid August 22, 1925 and set when 3 days old.
(WLBoc)2 WLC.	45.70	44.30	1.40	42.90	1.40	41.90	1.00	
Boc ¾	46.45	45.30	1.15	43.00	2.30	41.90	1.10	
Boc 15/16	47.53	45.90	1.63					
Cant.	39.20	37.60	1.60					
BmBmBn.	46.00	44.45	1.55					
Total			7.98		5.70		3.10	
Average			1.33		1.90		1.03	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

WLBocWLCant.	44.50	43.45	1.05	41.05	2.40	39.40	1.65	These eggs were laid August 23, 1925 and set when 2 days old.
(LBoc)2 WLCant	52.70	51.20	1.50	49.00	2.20	48.00	1.00	
Boc 3/4	45.78	44.40	1.38					
Boc 15/16	45.35	43.85	1.60					
Cant.	37.25	35.65	1.60	43.00	2.65	32.60	0.40	
BmBmBn	47.10	45.60	1.50	43.80	1.80	42.70	1.10	
Total			8.63		9.05		4.15	
Average			1.44		2.26		1.04	

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs	7th day	14th day	19th day	Grand total	Remarks
5 days old	1.48	1.82	1.10	4.40	
4 days old	1.49	1.47	0.84	3.80	
3 days old	1.33	1.90	1.03	4.26	
2 days old	1.44	2.26	1.04	4.74	
Total	5.74	7.45	4.01		
Average	1.44	1.86	1.00	4.30	
Average incubator temperature	101°F	102°F	104°F	307°F = 102°F	
Average temperature of incubator cellar	83°F	83°F	82°F	248°F = 83°F	
Amount of moisture sprinkled		1,560 cc	620 cc	2,180 cc	

NOTE.—All weights measured in grams.

TRIAL No. III—Continued

Set No. 3.—Sand moist with water from the 8th day to the end of incubation.

TABLE 9.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
BmBmBn	25	11	44.00	1	4.00	2	8.00	2	8.00	9	36.00	64.28	These eggs were set. September 6, 1925
(WLBoc)2 WLC	14	2	14.28	1	7.14	0	0.00	1	7.14	10	71.42	83.33	
Boc ¾	15	0	00.00	1	6.67	0	0.00	2	13.34	12	80.00	80.00	
Cant.	61	3	4.91	4	6.56	2	3.28	9	14.76	43	70.52	74.13	
BmBn ⅞	5	1	20.00	0	0.00	0	0.00	2	40.00	2	40.00	50.00	
Boc 15/16	9	6	66.67	0	0.00	1	11.11	0	00.00	2	22.22	66.67	
Total	129	23	17.83	7	5.43	5	3.88	16	12.40	78	60.47	73.58	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
(WLBoc)2 WLC	49.10	47.95	1.15	46.20	1.75	45.20	1.00	These eggs were laid September 25, 1925 and set when 4 days old.
BmBmBn	49.60	48.00	1.60	46.10	1.90			
Boc ¾	54.00	52.10	1.90	50.50	1.60	49.20	1.30	
Cant.	39.00	37.50	1.50	36.00	1.50	34.80	1.20	
Total			6.15		6.75		3.50	
Average			1.54		1.69		1.17	
(WLBoc)2 WLC	52.40	50.50	1.90	48.10	2.40	46.50	1.60	These eggs were laid September 3, 1925 and set when 3 days old.
BmBmBn	45.60	44.40	1.20					
Boc ¾	51.80	50.00	1.80	48.10	1.90	46.60	1.50	
Cant.	44.00	42.10	1.90	40.00	2.10	38.40	1.60	
Total			6.80		6.40		4.70	
Average			1.70		2.13		1.57	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION—Continued

(WLBoc)2 WLC								These eggs were laid September 4, 1925 and set when 2 days old.
BmBmBn								
Boc ¾								
Cant.	40.15	38.40	1.75	36.50	1.90	35.00	1.50	
Total			1.75		1.90		1.50	
Average			1.75		1.90		1.50	
(WLBoc)2 WLC	38.40	37.00	1.40	35.40	1.60	34.50	0.90	These eggs were laid September 5, 1925 and set when 1 day old.
BmBmBn	55.60	53.60	2.00	51.30	2.30	49.60	1.70	
Boc ¾	50.25	48.80	1.45	47.20	1.60	46.00	1.20	
Cant.	50.80	48.80	2.00					
Total			6.85		5.50		3.80	
Average			1.71		1.83		1.27	

C. TOTAL AMOUNT OF MOISTURE LOST.

Age ef eggs	7th day	14th day	19th day	Grand total	Remarks
4 days old	1.54	1.69	1.17	4.40	
3 days old	1.70	2.13	1.57	5.40	
2 days old	1.75	1.90	1.50	5.15	
1 day old	1.71	1.83	1.27	4.81	
Total	6.70	7.55	5.51		
Average	1.68	1.89	1.38	4.95	
Average incubator temperature	102°F	102°F	103°F	307°F = 102°F	
Average temperature of incubator cellar	82°F	81°F	84°F	247°F = 82°F	
Amount of moisture added to dry sand				1,440 cc	

NOTE.—All weights measured in grams.

TRIAL No. IV

Set No. I.—Check—No water was added from the beginning until end of incubation

TABLE 10.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
WLBoc	16	3	18.75	1	6.25	2	12.50	2	12.50	8	50.00	61.54	These eggs were set November 27, 1925.
(WLBoc)2 WLC	16	5	31.25	1	6.25	0	.00	2	12.50	8	50.00	72.73	
BmBn ⅞	39	8	20.51	4	10.26	5	12.82	6	15.38	16	41.02	51.61	
BmBmBn	53	24	45.28	5	9.43	1	1.89	5	9.43	18	33.96	62.07	
BmBn	6	2	33.33	0	.00	1	16.67	1	16.67	2	33.33	50.00	
Total	130	42	32.31	11	8.46	9	6.92	16	12.31	52	40.00	59.09	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
WLBoc	49.70	48.00	1.70	45.60	2.40	43.90	1.70	These eggs were laid November 23, 1925 and set when 4 days old.
(WLBoc)2 WLC	53.00	51.20	1.80	49.20	2.00	47.70	1.50	
BmBn ⅞	50.80	48.90	1.90	46.65	2.25	44.90	1.75	
BmBmBn	43.20	42.00	1.20	40.10	1.90	38.80	1.30	
Total			6.60		8.55		6.25	
Average			1.65		2.14		1.56	
WLBoc	47.40	46.30	1.10	44.10	2.20	42.30	1.80	These eggs were laid November 24, 1925 and set when 3 days old.
(WLBoc)2 WLC	50.50	48.90	1.60	46.00	2.90	44.65	1.35	
BmBn ⅞	43.80	42.10	1.70	40.15	1.95	38.60	1.55	
BmBmBn	53.40	52.20	1.20	49.60	2.60	48.40	1.20	
Total			5.60		9.65		5.90	
Average			1.40		2.41		1.48	

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
WLBoc	48.40	45.70	2.70	42.40	3.30	39.80	2.60	These eggs were laid on November 25, 1925 and set when 2 days old.
WLBoc 2 WLC	51.80	50.00	1.80	47.30	2.70	46.50	1.10	
BmBn $\frac{7}{8}$	51.90	50.20	1.70	48.40	1.80	46.80	1.60	
BmBmBn	50.80	48.90	1.90	46.40	2.50	44.40	2.00	
Total			8.10		10.30		7.30	
Average			2.03		2.58		1.83	
WLBoc	54.60	53.35	1.25	50.80	2.55	47.80	1.00	These eggs were laid on November 26, 1925 and set when 1 day old.
WLBoc 2 WLC	52.00	50.20	1.80	47.35	2.95	46.30	1.05	
BmBn $\frac{7}{8}$	46.30	44.20	2.10	41.50	2.70	39.40	2.10	
BmBmBn	53.40	57.80	1.60	49.95	1.85	48.45	1.50	
Total			6.75		10.05		5.65	
Average			1.69		2.51		1.41	

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs	7th day	14th day	19th day	Grand total	Remarks
4 days old	1.65	2.14	1.56	5.35	
3 days old	1.40	2.41	1.48	5.29	
2 days old	2.03	2.58	1.83	6.44	
1 day old	1.69	2.51	1.41	5.61	
Total	6.77	9.64	6.28		
Average	1.69	2.41	1.57	5.67	
Average incubator temperature	102°F	103°F	103°F	308°F = 103°F	
Average room temperature	80°F	82°F	82°F	254°F = 81°F	

NOTE.—All weights measured in grams.

TRIAL No. IV—Continued

Set No. 2.—Eggs sprinkled with lukewarm water from the 8th day to 18th day of incubation

TABLE 11.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
Boc 7/8	29	6	20.68	4	13.79	2	6.89	0	0	17	58.62	73.91	These eggs were set December 5, 1925.
BmBmBn	21	3	14.28	0	.00	1	4.76	4	19.04	13	61.88	73.89	
WLBoc–WLCant	24	11	45.83	0	.00	0	.00	0	.00	13	54.16	100.00	
(WLBoc)2 WLCant	5	0	.00	0	.00	0	.00	1	20.00	4	80.00	80.00	
BmBn 7/8	13	2	15.38	1	7.69	1	7.69	1	7.69	8	61.52	72.72	
Boc 15/16	13	3	23.07	0	.00	2	15.38	0	.00	8	61.52	80.00	
WLBoc	15	0	.00	0	.00	1	6.67	1	6.67	13	86.71	86.66	
Total	120	25	20.83	5	4.17	7	5.83	7	5.83	76	63.33	80.00	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Boc 7/8	45.00	43.00	2.00	40.40	2.60	38.20	2.20	These eggs were laid December 1, 1925 and set when 4 days old.
BmBmBn	44.50	42.65	1.85	40.72	1.93	38.90	1.82	
WLBocWLCant	47.50	46.10	1.40	44.60	1.50	43.40	1.20	
BmBn 7/8	43.90	42.90	1.00	40.80	2.10	39.50	1.30	
Boc 15/16	46.10	44.45	1.65	42.60	1.85	40.70	1.90	
WLBoc	45.10	42.20	2.90	39.50	2.70	36.60	2.90	
Total			10.80		12.68		11.32	
Average			1.80		2.11		1.89	

Boc 7/8	52.40	51.10	1.30	50.05	1.05	48.70	1.35	These eggs were laid December 2, 1925 and set when 3 days old.
BmBmBn	45.00	43.50	1.50	42.20	1.30	40.45	1.75	
WLBocWLCant.	46.50	45.90	.60	43.40	2.50	41.80	1.60	
BmBn 7/8	43.60	41.90	1.70	40.40	1.50	39.00	1.40	
Boc 15/16	48.10	46.05	2.05	44.20	1.85			
WLBoc.	49.20	47.00	2.20	44.45	2.50	41.70	2.80	
Total			9.35		10.70		8.90	
Average			1.56		1.78		1.78	
Boc 7/8	49.40	48.00	1.40	46.60	1.40	44.85	1.75	These eggs were laid December 3, 1925 and set when 2 days old.
BmBmBn	47.90	46.20	1.70	44.65	1.55	43.10	1.55	
WLBocWLCant.	49.50	48.05	1.00	46.90	1.15	45.70	1.20	
BmBn 7/8	53.40	52.10	1.30	50.70	1.40	49.60	1.10	
Boc 15/16	48.25	46.60	1.65	44.90	1.70	42.65	2.25	
WLBoc.	42.50	40.70	1.80	39.00	1.70	37.05	1.95	
Total			8.85		8.90		9.80	
Average			1.48		1.48		1.63	
Boc 7/8	49.90	48.90	1.00					These eggs were laid December 4, 1925 and set when 1 day old.
BmBmBn	47.10	45.80	1.30					
WLBocWLCant.								
BmBn 7/8	43.55	42.20	1.35	40.00	2.20	38.90	1.10	
Boc 15/16								
WLBoc.								
Total			3.65		2.20		1.10	
Average			1.22		2.20		1.10	

NOTE.—All weights measured in grams.

TRIAL No. IV—Continued

Set No. 2.—Eggs sprinkled with lukewarm water from the 8th day to 18th day of incubation—Continued

TABLE 11.—*Results of incubation tests*—Continued

C. TOTAL AMOUNT OF MOISTURE LOST

Age of eggs	7th day	14th day	19th day	Total	Remarks
4 days old	1.80	2.11	1.89	5.80	
3 days old	1.56	1.78	1.78	5.12	
2 days old	1.48	1.48	1.63	4.59	
1 day old	1.22	2.20	1.10	4.53	
Total	6.06	7.57	6.40	....	
Average	1.52	1.89	1.60	5.01	
Average incubator temperature	100°F	102°F	103°F	305°F–102°F	
Average room temperature	78°F	80°F	80°F	235°F– 79°F	
Total amount of moisture sprinkled	....	....	....	....	

Set No. 3.—Sand kept moist from the 8th day to end of incubation

TABLE 12.—*Results of incubation tests*

A. PERCENTAGES OF INFERTILITY AND OF HATCH

Breed	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shells		Hatch			Remarks
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs	
Boc $\frac{3}{4}$	3	3	100.00	0	0.00	0	.00	0	.00	0	.00	.00	These eggs were set December 16, 1925.
Boc $\frac{7}{8}$	27	5	18.50	1	3.70	4	14.80	2	7.40	15	55.50	68.18	
BmBmBn	20	1	5.00	0	.00	1	5.00	4	20.00	14	70.00	73.68	
WLBocWLC	10	4	40.00	0	.00	0	.00	0	.00	6	60.00	100.00	
(WLBoc)2 WLC	10	2	20.00	0	.00	2	20.00	0	00	6	60.00	75.00	
BmBn $\frac{7}{8}$	9	1	11.11	0	.00	1	11.11	3	33.33	4	44.44	50.00	
Boc 15/16	7	3	42.86	0	.00	0	.00	0	.00	4	57.12	100.00	
BmBn	3	0	.00	0	.00	0	.00	0	.00	3	100.00	100.00	
WLBoc	4	1	25.00	0	.00	0	.00	0	.00	3	75.00	100.00	
Boc	7	0	.00	0	.00	1	14.28	0	.00	6	85.68	85.68	
Expt	25	2	8.00	0	.00	1	4.00	4	16.00	18	72.00	78.26	
Total	125	22	17.60	1	.80	10	8.00	13	10.40	79	63.20	76.69	

B. LOSS OF MOISTURE FROM EGGS UNDER INCUBATION

Breed	Weight at the beginning	Weight on the 7th day	Loss	Weight on the 14th day	Loss	Weight on the 19th day	Loss	Remarks
Boc $\frac{7}{8}$	43.70	42.20	1.50	40.90	1.30	....	....	These eggs were laid December 12, 1925 and set when 4 days old.
BmBmBn	56.50	54.60	1.90	52.80	1.80	51.50	1.30	
WLBocWLC	46.80	45.10	1.70	43.15	1.95	41.90	1.25	
(WLBoc)2 WLC	54.10	52.10	1.90	50.40	1.80	49.40	1.00	
WLBocg	51.90	50.00	1.90	48.00	2.00	46.90	1.10	
Total	....	....	8.90	....	8.85	....	4.65	
Average	....	....	1.78	....	1.77	....	1.16	
Boc $\frac{7}{8}$	54.10	51.20	2.90	48.90	2.30	46.20	2.70	These eggs were laid December 13, 1925 and set when 3 days old.
BmBmBn	48.50	47.50	1.00	44.70	2.80	43.45	1.25	
WLBocWLC	47.65	46.50	1.15	....	....	....	....	
(WLBoc)2 WLC	53.35	52.30	1.05	49.90	2.40	48.70	1.20	
WLBocg	44.80	43.40	1.40	40.80	2.60	39.55	1.25	
Total	....	....	7.50	....	10.10	....	6.40	
Average	....	....	1.50	....	2.53	....	1.60	
BmBn $\frac{7}{8}$	50.60	48.95	1.65	46.00	2.95	44.30	1.70	These eggs were laid December 14, 1925 and set at the age of 2 days.
BmBmBn	49.35	47.60	1.75	45.80	1.80	44.70	1.10	
WLBocWLC	45.10	43.20	1.90	41.00	2.20	39.70	1.30	
(WLBoc)2 WLC	47.35	44.95	2.40	43.05	1.90	41.90	1.15	
WLBocg	42.80	41.45	1.35	40.00	1.45	39.35	.65	
Total	....	....	9.05	....	10.40	....	5.90	
Average	....	....	1.81	....	2.06	....	1.18	
Boc $\frac{7}{8}$	54.60	52.90	1.70	51.00	1.90	49.70	1.30	These eggs were laid December 15, 1925 and set at the age of 1 day.
BmBmBn	....	....	....	....	....	....	....	
WLBocWLC	49.50	47.50	2.00	45.30	2.20	44.22	1.08	
(WLBoc)2 WLC	55.60	53.10	2.50	50.80	2.30	49.35	1.45	
WLBocg	46.20	44.52	1.68	42.85	1.67	41.90	.95	
Total	....	....	7.88	....	8.07	....	4.78	
Average	....	....	1.97	....	2.02	....	1.10	

NOTE.—All weights measured in grams.

TRIAL No. IV—Continued

Set No. 3.—SAND KEPT MOIST FROM THE 8TH DAY TO END OF INCUBATION—Continued

TABLE 12.—*Results of incubation tests*—Continued

C. TOTAL AMOUNT OF MOISTURE LOST.

Age of eggs	7th day	14th day	19th day	Grand total	Remarks
4 days old	1.78	1.77	1.16	4.71	
3 days old	1.50	2.53	1.60	5.63	
2 days old	1.81	2.06	1.18	5.05	
1 day old	1.97	2.02	1.20	5.19	
Total	7.06	8.38	-5.14	....	
Average	1.77	2.20	1.29	5.15	
Average incubator temperature	101°F	102°F	103°F	306°F = 102°F	
Average room temperature	80°F	83°F	83°F	246°F = 82°F	
Amount of moisture added to dry sand	....	....	....	....	

SUMMARY OF RESULTS

TABLE 13.—*Percentage of infertility and of hatch*

SET NO. 1.—CHECK—NO WATER ADDED TO EGGS FROM BEGINNING UNTIL END OF INCUBATION

	Number of eggs set	Infertility		Dead germs first week		Dead germs second week		Died in shell		Hatch		
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent of all eggs	Per cent of fertile eggs
Trial No. I	125	30	24.00	5	4.00	9	7.20	31	24.80	50	40.00	52.63
Trial No. II	112	28	25.00	1	.89	10	8.93	23	20.54	50	44.64	59.52
Trial No. III	118	28	23.73	13	11.02	9	7.63	10	8.47	58	49.15	64.44
Trial No. IV	130	42	32.31	11	8.46	9	6.92	16	12.31	52	40.00	59.09
Total	485	128	26.39	30	6.19	37	7.63	80	16.49	210	43.29	58.82

SET NO. 2.—EGGS SPRINKLED WITH LUKEWARM WATER FROM THE 8TH DAY TO 18TH DAY OF INCUBATION

Trial No. I.	121	34	28.10	0	.00	13	10.74	25	20.66	49	40.50	56.32
Trial No. II.	88	20	22.72	4	4.55	4	4.55	14	15.91	46	52.27	67.65
Trial No. III.	107	32	29.92	1	0.93	8	7.48	12	11.21	54	50.47	72.00
Trial No. IV.	120	25	20.83	5	4.17	7	5.83	7	5.83	76	63.33	80.00
Total.	436	111	25.46	10	2.29	32	7.34	58	13.30	225	51.61	69.23

SET NO. 3.—SAND WAS KEPT MOIST WITH WATER FROM THE 8TH DAY TO END OF INCUBATION.

Trial No. I.	120	26	21.67	2	1.67	18	16.67	12	10.00	72	60.00	76.60
Trial No. II.	121	23	19.01	4	3.31	13	10.74	17	14.05	64	52.89	65.31
Trial No. III.	129	23	17.83	7	5.43	5	3.88	16	12.40	78	60.47	73.58
Trial No. IV.	125	22	17.60	1	0.80	10	8.00	13	10.40	79	63.20	76.69
Total.	495	94	18.99	14	2.83	36	7.27	58	11.72	293	59.19	73.07

TABLE 14.—*Average weight of chicks just after hatching*

Breed	Check	Sprinkled	Sand
Boc 7/8	0.00	29.90	28.25
BmBn 3/4	0.00	29.65	30.20
WLBocWLCant.	28.05	29.60	27
BmBn 7/8	34.10	33.10	0.00
WLBoc.	30.25	29.10	37.20
Total	92.40	151.35	122.65
Average	30.43	30.80	30.88

TABLE 15.—*Total amount of moisture lost*

SET NO. 1.—CHECK—NO WATER ADDED DURING THE INCUBATION, FROM BEGINNING UNTIL THE END.

	1st week	2nd week	19th day	Total	Room temperature	Average incubator temperature	Remarks
Trial No. I.	2.16	1.99	1.69	5.84	87°F	103°F	
Trial No. II.	1.61	2.49	1.43	5.53	86°F	102°F	
Trial No. III.	1.63	1.93	1.69	5.25	83°F	102°F	
Trial No. IV.	1.69	2.41	1.57	5.67	81°F	103°F	
Total.	7.09	8.82	6.38	....	....	....	
Average.	1.77	2.21	1.60	5.58	....	....	

SET NO. 2.—EGGS WERE SPRINKLED WITH LUKEWARM WATER EVERY DAY, FROM THE 8TH TO 18TH DAY.

Trial No. I.	1.09	1.84	0.98	3.91	87°F	103°F	1,440 cc.
Trial No. II.	1.63	1.87	1.23	4.73	86°F	102°F	3,640 cc.
Trial No. III.	1.44	1.86	1.00	4.30	83°F	102°F	2,180 cc.
Trial No. IV.	1.52	1.89	1.60	5.01	79°F	102°F	
Total.	5.68	7.46	4.81	....	....	....	
Average.	1.42	1.87	1.20	4.39	....	....	

SET NO. 3.—INCUBATOR—SAND WAS KEPT MOIST FROM THE 8TH DAY TILL THE END OF INCUBATION.

Trial No. I.	1.60	1.26	1.02	3.88	87°F	103°F	860 cc.
Trial No. II.	1.40	1.48	1.25	4.13	85°F	103°F	1,840 cc.
Trial No. III.	1.68	1.89	1.38	4.95	82°F	102°F	1,440 cc.
Trial No. IV.	1.77	2.20	1.29	5.26	82°F	102°F	
Total.	6.45	6.83	4.94	....	....	....	
Average.	1.61	1.71	1.24	4.56	....	....	

TOTAL AVERAGE OF MOISTURE LOST IN THE THREE SETS

Set No. 1—Check.	1.77	2.21	1.60	....	....	....
Set No. 2—Sprinkled.	1.42	1.87	1.20	....	....	....
Set No. 3—Sand.	1.61	1.71	1.24	....	....	....
Total.	4.80	5.79	4.05	....	....	....
Average.	1.60	1.93	1.35	4.88	....	....

TABLE 16.—*Amount of moisture lost from eggs, one to five days old, at time incubation started*

SET NO. 1.—CHECK—NO WATER ADDED FROM BEGINNING UNTIL THE END.

	Age of eggs when set				
	1 day	2 days	3 days	4 days	5 days
Trial No. I	6.21	5.99	6.02	5.13	....
Trial No. II	....	5.59	5.60	5.39	....
Trial No. III	....	5.36	5.49	4.93	5.23
Trial No. IV	5.61	6.44	5.29	5.35	....
Total	11.82	23.38	22.30	20.80	5.23
Average	5.91	5.85	5.58	5.20	5.23

SET NO. 2.—EGGS WERE SPRINKLED WITH WATER EVERY DAY, FROM 8TH DAY TO 18TH DAY.

Trial No. I	4.63	3.63	3.47	....	....
Trial No. II	4.61	4.99	5.32	4.02	....
Trial No. III	....	4.74	4.26	3.80	4.40
Trial No. IV	4.53	4.59	5.12	5.80	....
Total	13.77	17.95	18.17	13.62	4.40
Average	4.59	4.49	4.54	4.54	4.40

SET NO. 3.—INCUBATOR—SAND KEPT MOIST FROM 8TH DAY UNTIL THE END OF INCUBATION.

Trial No. I	....	4.055	3.68	3.835	3.96
Trial No. II	....	4.33	3.65	4.15	4.40
Trial No. III	4.81	5.15	5.40	4.40	....
Trial No. IV	5.19	5.05	5.60	4.71	....
Total	10.00	18.58	18.36	17.095	8.36
Average	5.00	4.65	4.59	4.27	4.18

TOTAL AVERAGES

Check	5.91	5.85	5.58	5.20	5.23
Sprinkled	4.59	4.49	4.54	4.54	4.40
Sand	5.00	4.65	4.59	4.27	4.18
Total	15.50	14.99	14.71	14.01	13.81
Average	5.17	4.99	4.90	4.67	4.60

In the four trials performed, the percentage of hatch of the eggs placed in an incubator provided with damp sand, in most cases was higher than either that for the eggs in setting No. 1 (check) or that for the eggs sprinkled with lukewarm water. The percentage of infertility was highest in setting No. 1 or check. Summarizing the results of the four trials as in table 13, it may be seen that the percentage of infertility of setting No. 1 (check) was 26.39 per cent; that of setting No. 2, (sprinkled) 25.46 per cent, and that of setting No. 3 (sand) was 18.99 per cent. Therefore the eggs in setting No. 1, were 3.22 per cent more infertile than that of the sand setting. Con-

sequently setting No. 3 (sand) had the least number of eggs that passed as infertile and setting No. 2 (sprinkled) second.

The greatest number of dead germs during the first week of incubation was recorded for the check set—6.19 per cent; sand set, 2.82 per cent, second, and set No. 3—sprinkled 2.29 per cent which was 3.37 per cent more than that of the sand set and 3.90 per cent more than that of the sprinkled set.

The highest percentage of dead germs for the second week of incubation was found on the check set, 7.63 per cent; the sprinkled set, 7.34 per cent second, and sand set 7.27 per cent. This shows that the check set had a percentage of dead germs for the second week of incubation of 29 and 36 per cent more than those of the sprinkled set and sand set respectively.

The percentage of chicks that died in the shells in the case of setting No. I (check) was 16.49 per cent while the percentages of the sprinkled set and sand set were 13.30 and 11.72 per cent respectively giving a difference of 3.19 per cent from the sprinkled set and 4.77 per cent from the sand set.

The percentage of hatch on the sand setting, 73.07 per cent, was highest, while that of the sprinkled setting, 69.23 per cent, was second and that of the check setting was third giving 58.82 per cent. The percentage of hatch in this case was based upon all fertile eggs. Therefore the percentage of hatch for the sand setting was 13.25 per cent more than that of the check setting and 3.84 per cent more than that of the sprinkled setting. Basing the percentage of hatch upon the number of eggs setting the percentage of hatch of the sand setting was 15.88 per cent, higher than that of the check setting and 7.56 per cent more than that of the sprinkled setting.

Table 14 shows that there was no appreciable difference between average weight of newly hatched chicks on the three settings. The average weight of a newly hatched chick in case of the sand setting was 30.88 grams, that of the sprinkled setting was 30.43 grams, and that of the check setting was 30.80 grams.

Table 15 shows that the total average amount of moisture lost from an egg in the check lot was 5.58 grams while those from eggs in the sprinkled setting and sand setting were 4.39 grams, 4.56 grams each giving a difference of 1.19 and 1.02 grams respectively. The small amount of moisture evaporated from eggs in both the sprinkled set and the sand setting may be attributed to the moisture artificially added to them.

In the check lot of table 15, the total amount of moisture evaporated from an egg on the first trial was 5.84 grams when the room temperature and the incubator temperature were 87.° and 103°F, while it was only 5.25 grams when the room temperature and the incubator temperature were 83° and 102°F in case of trial No. III. And in trial No. IV the average amount moisture evaporated from an egg when the room temperature and incubator temperature were 81° and 103°F, was 5.67 grams.

This shows that the amount of moisture evaporated from an egg under incubation is not controlled by the room temperature as shown by the fact that 5.67 grams evaporated from an egg at room temperature of only 81°F while the amount of moisture evaporated from an egg at a room temperature of 83°F was only 5.25 grams.

This also shows that the amount of moisture evaporated from an egg under incubation is greatly controlled by the incubator temperature as shown by the fact that 5.84 grams evaporated from an egg at an incubator temperature of 103°F and only 5.25 grams evaporated from an egg at incubator temperature of 102°F. The amount of moisture evaporated from an egg at low average room temperature, but with high average incubator temperature is more than that from an egg at high room temperature but with low incubator. This is shown by the fact that the amount of moisture evaporated from an egg at average room temperature of 83°F, with average incubator temperature of 102°F was 5.25 grams while that from an egg at room temperature of 81°F with average incubator temperature 103°F, was 5.67 grams. The highest amount of moisture evaporated from an egg was 5.84 grams when it was at high room temperature of 87°F and also high incubator temperature of 103°F.

But these figures are not true in case of eggs receiving an artificial supply of moisture. The evaporation of moisture from eggs was greatly influenced by the moisture artificially added. In setting No. 2 (sprinkled) the amount of moisture evaporated from an egg, with average room temperature of 87°F and with average incubator temperature of 103°F, was 3.91 grams only, while that from egg at room temperature of only 83°F with incubator temperature of 102°F was 4.30 grams which was 0.39 gram more than that of the former. In the case of the sand setting, only 3.88 grams of moisture evaporated from an egg at room temperature of 87°F and with incubator temperature of

103°F, while from an egg at room temperature of 82°F with incubator temperature of 102°F, 4.95 grams of moisture evaporated.

Table 15 also shows that, in all cases, the amount of moisture lost on the fourteenth day was greater than either that of the seventh day or that of the nineteenth day. The amount lost the first week was greater than that from the second week up to the nineteenth day. The total amount of moisture lost on the seventh day was 1.60 grams; the fourteenth day, 1.93 grams; and the nineteenth day, 1.35 grams.

Table 16 shows that the amount of moisture evaporated from an egg during the period of incubation decreases as it becomes older. The amount of moisture evaporated from an egg set at the age of 5 days was 4.60 grams; 4 days old, 4.67 grams; 3 days old, 4.90 grams; 2 days old, 4.99 grams and at 1 day old was 5.17 grams.

SUMMARY

1. A greater percentage of hatch was obtained from the eggs when the incubator was artificially supplied with moisture than that where the incubator did not receive an artificial supply of moisture. The incubator provided with wet sand gave the highest percentage of hatch of 59.19 per cent of all eggs set and 73.07 per cent of all fertile eggs; the one sprinkled with lukewarm water ranks next giving a percentage of hatch of 51.61 per cent of all eggs set and 69.23 per cent of all fertile eggs. The check set gave a percentage of hatch of 43.29 per cent of all eggs set and 58.82 per cent of all fertile eggs.

2. More eggs in the check setting were passed as infertile than in either of the sprinkled or the sand lots.

3. There was no appreciable difference in the average weight of newly hatched chicks in the three settings.

4. The amount of moisture lost from eggs under incubation is regulated by the incubator temperature and not by the room temperature.

5. The amount of moisture lost in the check set (5.58 grams) was more than that lost either in the sprinkled set (4.39 grams) or the sand set (4.56 grams), the last two having no appreciable difference. The moisture lost on the fourteenth day (1.93 grams) was greater than that lost on either the seventh day, 1.60 grams, or on the nineteenth day, 1.35 grams. The amount of moisture lost on the seventh day was .25 gram greater than that of the nineteenth day.

6. The amount of moisture evaporated from eggs under incubation decreases as they become older. The amount of moisture lost from eggs set at 5 days old was 4.60 grams, 4.67 grams to 4 days old 4.90 grams to 3 days old; 4.99 grams to 2 days old and 5.17 grams to 1 day old.

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THE AVOCADO—A VALUABLE FRUIT[1]

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INTRODUCTION

Within the last twenty-five years, hundreds of species and varieties of plants were introduced into the Philippines. These were brought from many different countries of the world, and include fruit, vegetable, forage, medicinal and other groups of plants. Some of these are valuable plants, indeed, others are less so, while still others are worthless. Very many of these new plants have already proved well adapted to our soil and climate, while others are less promising. One of the recent acquisitions, which, because of its high economic value as well as its ready adaptation to Philippine soil and climate, is destined to become one of our most popular fruits here, is the avocado. To most persons in the Philippines, this fruit is entirely unknown, at present. The following contains brief information regarding the origin, culture, and uses of the avocado, and is intended to help the prospective planters of this important tropical fruit tree in the Philippines.

ORIGIN AND BOTANY

The avocado, *Persea gratisima,* Gaertn, is one of the most valuable food plants introduced into the Philippines, in recent years. This fruit is usually known as "aguacate" in Spanish, and as "alligator pear" and "avocado" in English. The latter English name for the fruit is more fitting than the former, and is, by far, to be preferred.

The original home of the avocado is tropical and semitropical North and South America. It has gradually been introduced into most tropical and semitropical countries of the world. Its successful introduction into the Philippines dates back only about twenty-five years ago.

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[1] Bureau of Agriculture Circular No. 212.

The plant belongs to the cinnamon family, and the leaves of many varieties possess, in varying degrees, the spicy odor and taste common to the plants of this family. The tree is of good size, attaining under favorable conditions, a height of 60 to 80 feet. It has a large number of varieties, and therefore both the tree and fruit characters are widely variable. As a rule, the fruit is slightly larger than the carabao mango, pear-shaped, and has a seed of the size and form of a hen's egg. When ripe the surface color of the fruit varies from light or dark green to purple, crimson, or maroon. Around the seed is the edible flesh. This has a fine texture and a consistency resembling that of butter. The meat has a pleasant, nutty flavor.

FOOD VALUE

The avocado distinguishes itself from other fruits in that it has a very high food value. The composition of twenty-eight varieties of avocado has been presented by E. M. Jaffa, in Bulletin No. 254 of the California Agricultural Experiment Station. These varieties showed a fat content of the flesh, ranging from 9.8 to 29.1 per cent and a protein content ranging from 1.3 to 3.7 per cent. Professor Jaffa mentions the fact that the energy value of the avocado is more than double that of other commonly used fresh fruits. He also believes that the dietetic value of this fruit must be high, possessing as it does the combination of the usual "fruit principles," and that of fat or oil. When grown extensively the avocado might be made to supply a large proportion of the fatty element in our diet. It has been known in the countries where it has long been grown that this fruit is a wholesome and highly digestible food.

USES

In the Philippines, the most common way in which the avocado is eaten, is to add sugar and milk and eat it as a dessert, or in the form of ice-cream. Some persons relish the meat with nothing added to it, eating it alone or using it as butter spread on bread, while other persons with salad dressing.

POSSIBILITIES

The growing of the avocado is a promising commercial venture in the Islands. The fruit is as yet, very rare and costly, being sold only in a few restaurants in Manila and at a high price.

There are now avocado trees growing in widely separated localities in the Philippines and the behavior of these trees clearly

indicates that the plant is at home in this country. In localities where the dry season is not too prolonged they thrive with very little attention. However where the dry season extends to four or five months at a time, they require some irrigation unless the soil moisture is within reach of the roots during the driest part of the year.

SOIL

Deep, well drained sandy loam soils are best for the avocado, but heavier soils of average fertility will also grow good avocado. Good drainage is essential to the successful culture of the avocado. For this reason, a gently sloping land make an ideal location for an avocado orchard. The avocado is quite resistant to the injurious action of strong winds, so that even on hilly or exposed ground, trees may be grown to advantage.

PROPAGATION

There are two principal means of propagating the avocado—by seed and by budding. Trees grown from seed are known to be very variable in nature. They often come into fruiting late, and they can not be relied upon to give satisfactory crops of a uniformly good quality. A much better method of propagating this tree is by budding. Trees grown by this method possess several important advantages some of which are: their precocity, good bearing habits, low and shrubby growths, and uniformity of character.

The first step in the production of budded trees, is the raising of the seedling stocks. The seed of the avocado quickly losses its vitality. It should, therefore, be planted while it is still as fresh as possible. A rich soil with plenty of humus should be used. In planting the seed, its narrow end is left slightly protruding above the surface of the ground.

When a small number is to be grown, the seeds may be planted separately in small nursery pots so that, in repotting them, later on, the roots will only be disturbed as little as possible. The roots of the avocado, at this time, are few and delicate. If the number to be grown is large, the seeds may first be germinated in seed boxes, having a depth of, at least 8 inches or in seed beds. These should be under partial shade. The seeds are placed at about 5 inches apart each way, and as each seed germinates, and has attained a 4- or 5-inch shoot, it is carefully removed, potted singly, or planted in rows in the ground. In the former case, a good sized pot, 8 to 10 inches

in diameter should be used. A rich soil is to be used, and the seedling is given careful attention to keep it in vigorous growth, so that it will easily take the bud. If necessary, repot it once, to give ample room and nourishment to the rapidly developing root system, before it is budded. There is less difficulty, in keeping the seedlings in good condition for budding when they are planted in the ground, but it will require more labor to properly remove them and transplant them to the orchard.

BUDDING

The budding may begin any time the stem of the seedling stock has attained a size slightly larger than a lead pencil. The scion should be selected from the best tree of the desired variety. This should be of a recent growth, and should contain plump, well developed buds.

The ordinary form of shield budding as used in the propagation of citrus trees has been most successful with the avocado. The only modification in the process is that, in forcing the bud to grow, after it has taken, a ring of bark about an inch above the bud is removed, instead of cutting a notch deep into the wood of the stock. This is to avoid a premature breaking of the wood which is very brittle at this stage. In addition to this means of forcing the bud to grow, the top of the stock, about 10 inches from the bud, may be cut off. After the bud has grown to a length of 8 or 10 inches, the stock should be cut off clean just above the bud union, and the cut is immediately covered with white lead, asphaltum or grafting wax. If the cut is left exposed without this protective covering, the wood has the tendency to rot, soon, causing the death of the bud and all.

PLANTING

The trees may be planted in the orchard any time during the wet season, provided it is early enough to have them well established when the dry season comes. With ample facilities for watering them, they may, of course, be planted late in the rainy season, and even during the dry season. To facilitate the removal of the trees from the nursery, it is advantageous to transplant them to the orchard when they are still small that is, when the shoots are but 12 inches long, or so. The avocado is a rapid grower when given ample space in which to develop. Therefore, after the trees have had sufficiently hardened buds, the earlier they are transplanted, the better.

The trees are usually planted in the orchard at a distance apart nor closer than eight meters. Holes about 40 centimeters deep and 50 centimeters wide are dug, and the trees planted in them, using a good surface soil for refilling. The trees should be watered, mulched and shaded, if there is no prospect of rain-fall soon after the planting. The trees should be set in the holes as deep as they stood in the nursery or pots.

CULTIVATION

There appears to be no particular difficulty in maintaining the avocado tree in good condition if the soil is not poor. Its cultural requirement is not exacting, and the writer has seen it thrive under tillage as well as under no tillage. When grown in the home yard, the tree has been maintained in excellent condition by only an occasional hoeing of the ground near its base. It is probable, however, that, in the care of young orchards, tillage and cultivation are beneficial during the dry season, and that during the rainy season, cover crops should be planted to hold the soil from erosion, as well as to replenish the nitrogen and organic matter contents of the soil.

FERTILIZATION

So as to get the most profit from the trees, it is always a good plan to maintain, and if possible build up, the fertility of the soil. Therefore, attention should be given to the manuring of the young trees if the soil is not rich. And for bearing trees a regular application of fertilizers should be made. These may consist of from 1 to 3 kilos of a fertilizer containing 8 per cent nitrogen, 4 per cent phosphoric acid, and 3 per cent potash, per tree a year for the young trees; and for the bearing trees, from 4 to 6 kilos of a fertilizer containing 6 per cent nitrogen, 4 per cent phosphoric acid, and 4 per cent potash, per tree per year. The stated amount of fertilizer should be applied twice in the year.

VARIETIES

An important problem connected with the growing of avocado trees in the Philippines, is the selection of varieties. Many trees which are now found growing here, are shy bearers. Fortunately, there are many excellent varieties which have already been brought to this country, and some of these are well adapted to the local conditions. Moreover, it is probable that some of the seedling trees now growing in scattered places in the Islands

may be found to have excellent qualities to commend them for propagation. In searching for varieties that should be grown, the following qualifications should be sought:

1. Precocious, prolific and regular bearer.
2. Tree of vigorous growth and good form.
3. The fruit should be of good flavor and quality.
4. The seed should be small and tight in the cavity.
5. Varieties which mature their fruits at different months of the year should be selected.

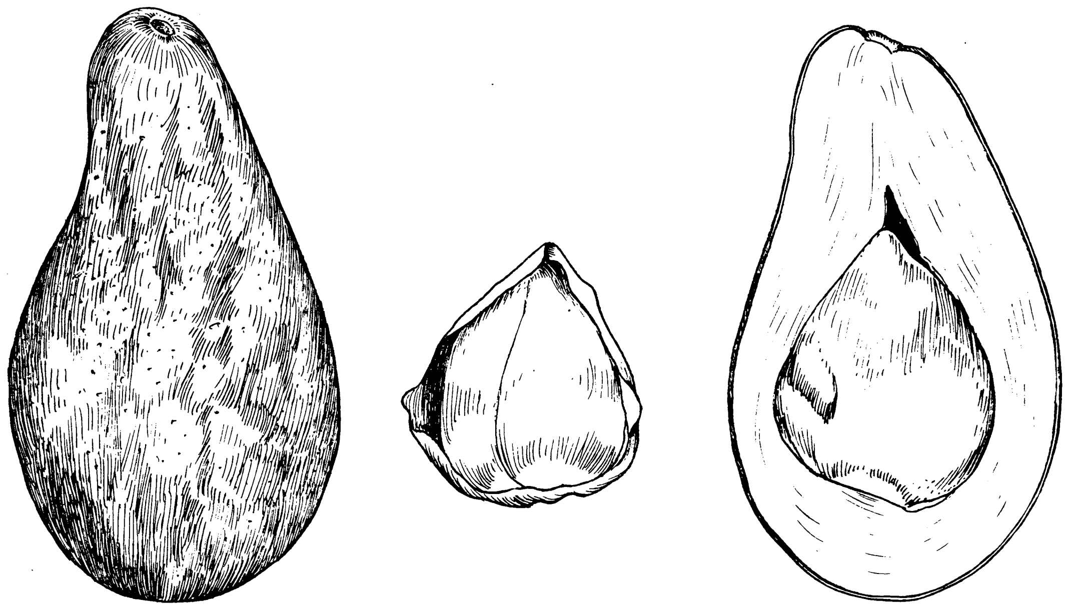
A DESCRIPTIVE LIST OF THE DIFFERENT AVOCADO VARIETIES AT THE LAMAO EXPERIMENT STATION, LAMAO, BATAAN

Family.—Fruits: Obovate sometimes distinctly necked; size large; weight 310 to 590 grams; length 5 to 5½ inches; greatest breadth 3½ to 3⅛ inches; base narrow; stem slender, ½ to 1¼ inches long, inserted obliquely in a shallow, flaring regular cavity; apex obliquely flattened; surface smooth and glossy, very light yellowish green before ripening but deep purple to blood red color when ripe, with light yellow dots; skin $\frac{1}{32}$ inch thick adhering closely to the flesh although it can be easily peeled off; flesh a buttery cream yellow changing to yellowish green close to the skin with fibers at the basal and apical portions; rich flavor; good quality; seed oblong to conic, large and loosely located in the seed cavity with the seed coat adhering closely. Season July and August.

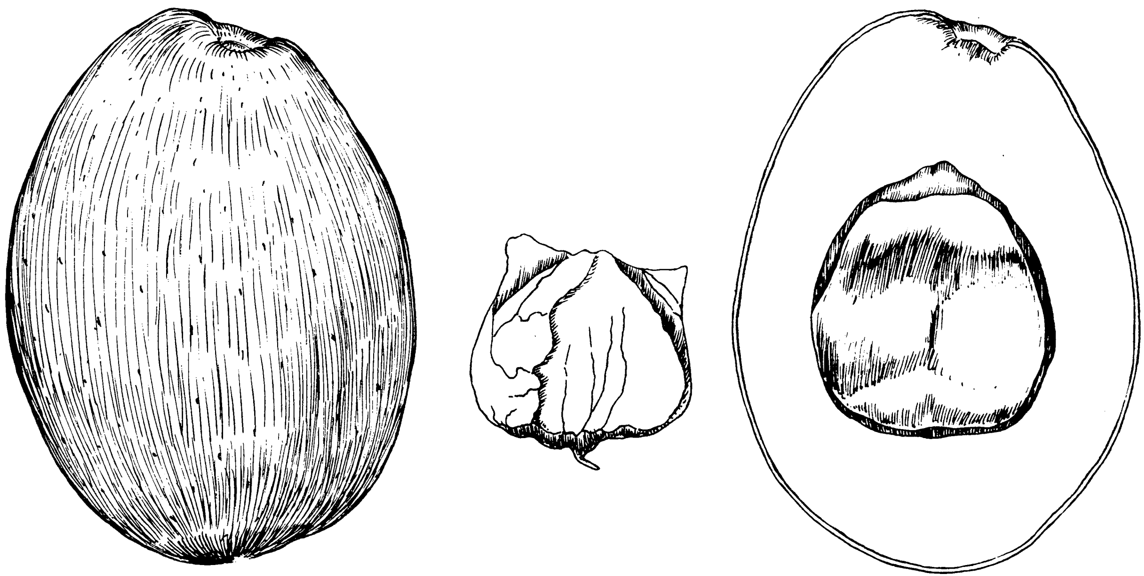
Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915, regular bearer and the average annual yield for 4 years fruiting is 50 fruits; slightly attacked by wood borer. The tree has become adapted to the soil and climate conditions of Lamao, Bataan.

Pollock.—Obovate to oblong pyriform; size large; weight 300 to 800 grams; length 5½ to 7 inches; greatest breadth 3½ to 4½ inches; base narrow, slightly flattened with the short stem 1⅛ to 2¾ inches inserted obliquely in a shallow, flaring regular cavity; apex obliquely flattened or slightly depressed; surface smooth, glossy, light yellowish green with longitudinal yellow lining, and numerous small greenish yellow or russet dots; skin $\frac{1}{32}$ inch thick, separating very readily from the flesh, tough and leathery; flesh firm, smooth and fine in texture, deep yellow changing to yellowish green towards the skin; of rich flavor and excellent quality; seed rather small and conic in shape, usually fitting closely in the cavity; seed coats rather loose, more or less separate. Season August and September.

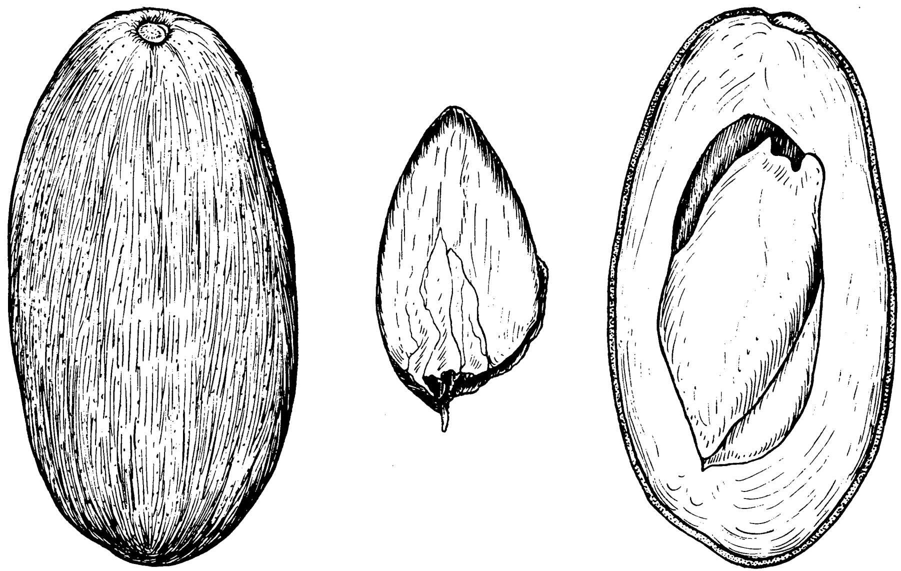
Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915; regular



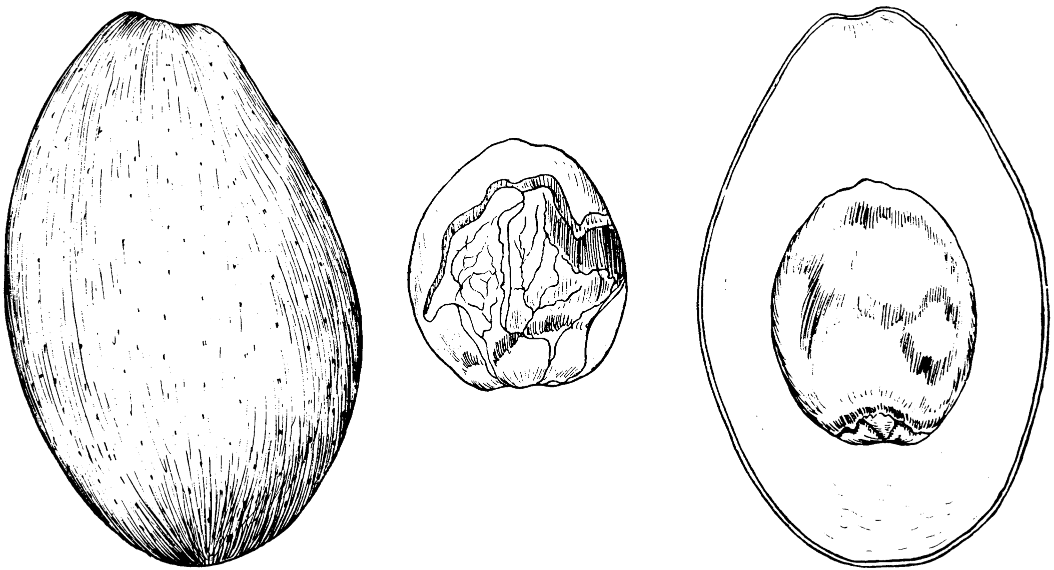
"FAMILY" Avocado



"POLLOCK" Avocado



"LYON" Avocado



"DOUGLAS" Avocado

heavy bearer and the average annual yield for 4 years fruiting is 95 fruits; slightly attacked by wood borer; has adapted itself to the soil and climatic conditions of Lamao, Bataan.

Lyon.—Form oblong pyriform and indistinctly necked; size above medium to large; weight 470 to 940 grams; length $5\frac{1}{2}$ to $7\frac{7}{8}$ inches; greatest breadth $2\frac{3}{4}$ to $3\frac{7}{8}$ inches; base narrow; stem generally $1\frac{7}{16}$ inches long inserted obliquely almost without depression; surface undulating to rough bright green in color with numerous small yellowish or russet dots; skin moderately thick ($\frac{1}{16}$ inch) separating readily from the flesh; coarsely granular brittle and not much change in color when ripe; flesh smooth, firm deep cream color tinged with green toward the skin, almost free from fiber discoloration; rich flavor; quality good; seed conic; medium small in size, fitting tightly in the cavity with the seed coats adhering closely. Season July and August.

Introduced from abroad and planted in the Lamao Experiment Station in 1913; regular bearer and the average annual yield for 2 years fruiting is 70 fruits; badly attacked by wood borers but the tree is adapted to soil and climatic conditions in Lamao.

Douglas.—Form obovate to pyriform and indistinctly necked; size medium large; weight 370 to 510 grams; length $4\frac{1}{2}$ to 5 inches; greatest breadth 3 to $3\frac{7}{8}$ inches; base narrow, the short stem $\frac{3}{4}$ to 1 inch long inserted obliquely in a regular shallow flaring cavity; apex rounded; surface smooth and glossy, yellowish green before ripening and deep purple when ripe with yellow dots; skin $\frac{1}{32}$ inch thick adhering closely to the flesh but it can be easily peeled off; flesh cream yellow color, firm, practically free from fiber; rich flavor; good quality; seed broad conic to almost oval, loosely located in the cavity with the seed coats both adhering closely. Season August and September.

Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915; regular but very shy bearer; not attacked by wood borer, adapted to the soil and climatic conditions of Lamao.

Commodore.—Form obovate to pyriform; size small; weight 160 to 420 grams; length $4\frac{1}{4}$ to $4\frac{7}{8}$ inches, greatest breadth $3\frac{1}{4}$ to $4\frac{7}{8}$ inches; base narrow, stem slender 1 to $1\frac{1}{2}$ inches long inserted almost squarely in rather deep flaring regular cavity; apex rounded; surface glossy yellowish green before ripening and deep purple when ripe with small yellow dots;

skin $\frac{1}{16}$ inch thick, coarsely granular, brittle; flesh light yellow changing to very light yellowish green towards the skin, rather fibrous; rich flavor; quality fair; seed broad, conic, small fitting tightly in the cavity with the seed coats both adhering closely. Season August and September.

Introduced from coconut grove, Florida, in 1906 and planted in the Lamao Experiment Station in 1915; regular bearer and the average annual yield for 4 years fruiting is 45 fruits; not attacked by wood borer, adapted to the soil and climatic conditions of Lamao, Bataan.

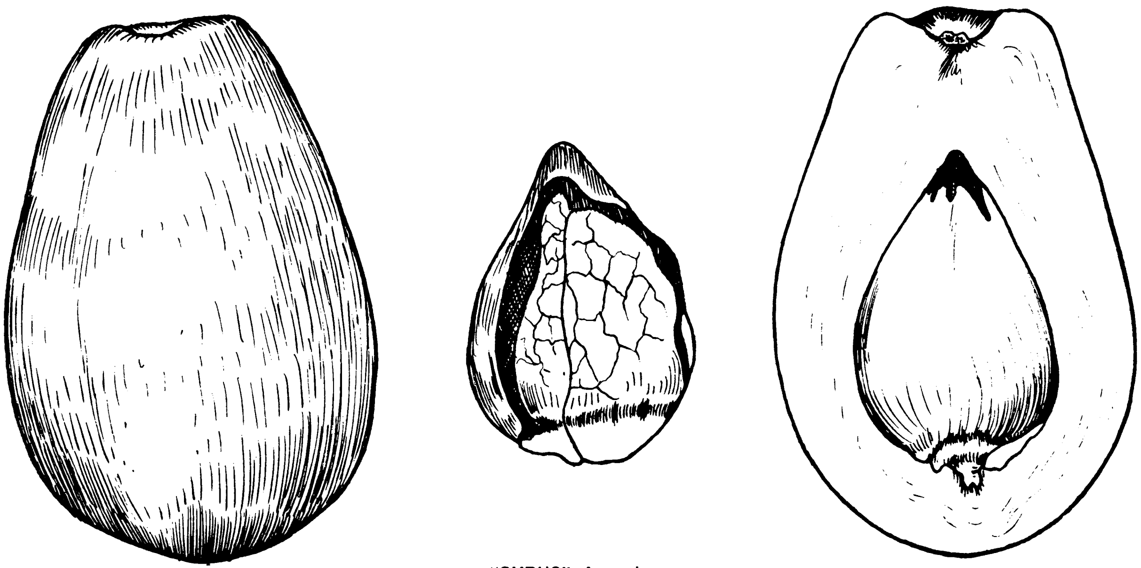
Cyrus.—Form oblong pyriform; size regular; weight 360 grams; length 4 to $5\frac{1}{4}$ inches; greatest breadth $3\frac{1}{4}$ to $3\frac{7}{8}$ inches; base narrow; stem slender, $2\frac{5}{8}$ to $4\frac{3}{4}$ inches long; inserted almost squarely in a rather deep flaring regular cavity; apex rounded almost without depression; surface smooth, glossy, greenish yellow or yellowish green even when ripe with yellow dots; skin $\frac{1}{32}$ inch thick, membranous, separating very readily from the flesh; flesh firm, smooth and fine in texture, yellow changing to yellowish green towards the skin; rich flavor good quality; seed loosely located in the seed cavity and the outer layer of the seed coats adhering closely to the seed cavity; seed coat always partly cracked at the apical portion like the molting bark of a tree. Season August and September.

Introduced from St. Petersburg, Florida, in 1907 and planted in the Lamao Experiment Station in 1915; regular bearer and the average annual yield for 4 years fruiting is 44 fruits; severely attacked by wood borer but adapted to the soil and climatic conditions of Lamao.

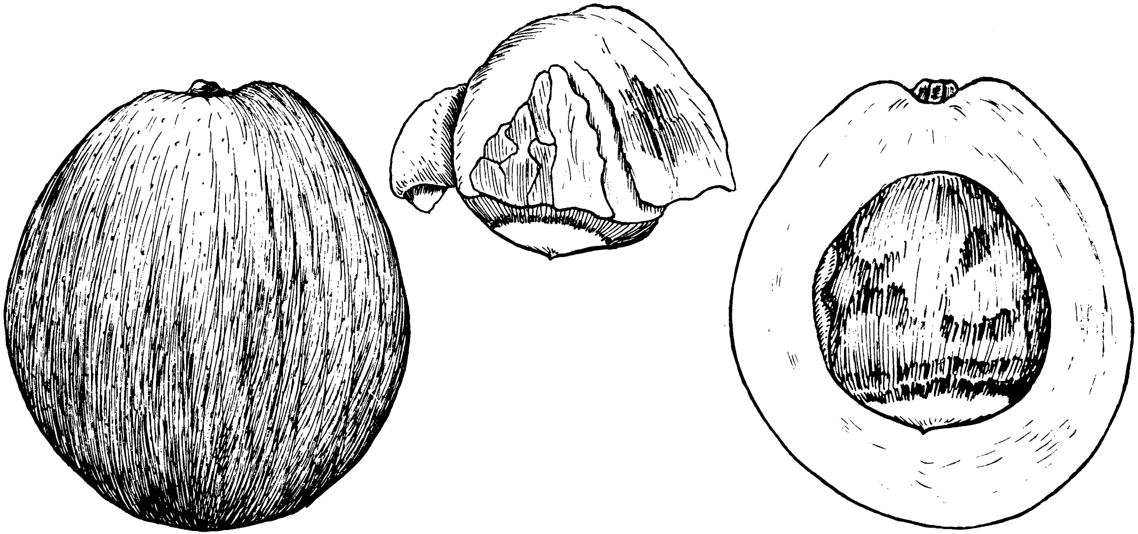
Wester.—Form roundish oblate, obliquely flattened at the apex; size medium large weighing 310 to 650 grams; length $3\frac{1}{2}$ to $4\frac{3}{4}$ inches; greatest breadth $3\frac{1}{2}$ to $4\frac{5}{16}$ inches; base narrowing slightly, flattened around the deep narrow regular flaring cavity in which the stem ($2\frac{1}{4}$ to $2\frac{3}{4}$ inches long) is inserted almost squarely; apex obliquely flattened; surface smooth glossy; skin $\frac{1}{16}$ inch thick, leathery light green color before ripening but turns to deep purple with maroon russet dots when ripe, adhering closely to the flesh; flesh firm, light yellow color changing to yellowish green towards the skin with very few traces of fibers around; rich flavor; quality good; seed broadly obate, large fitting tight in the seed cavity. Season August and September.

Introduced from the United States Department of Agriculture and planted in the Lamao Experiment Station in 1915;

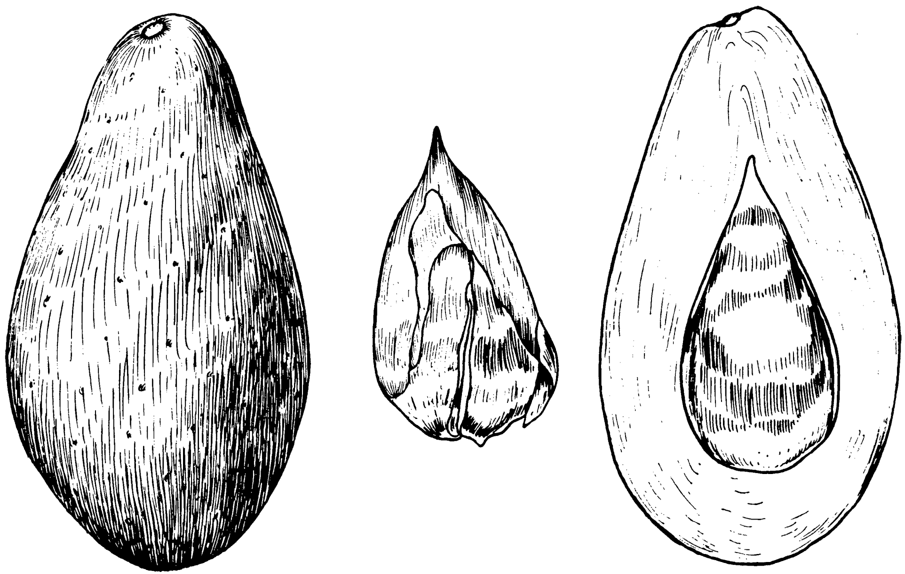
"COMMODORE" Avocado



"CYRUS" Avocado

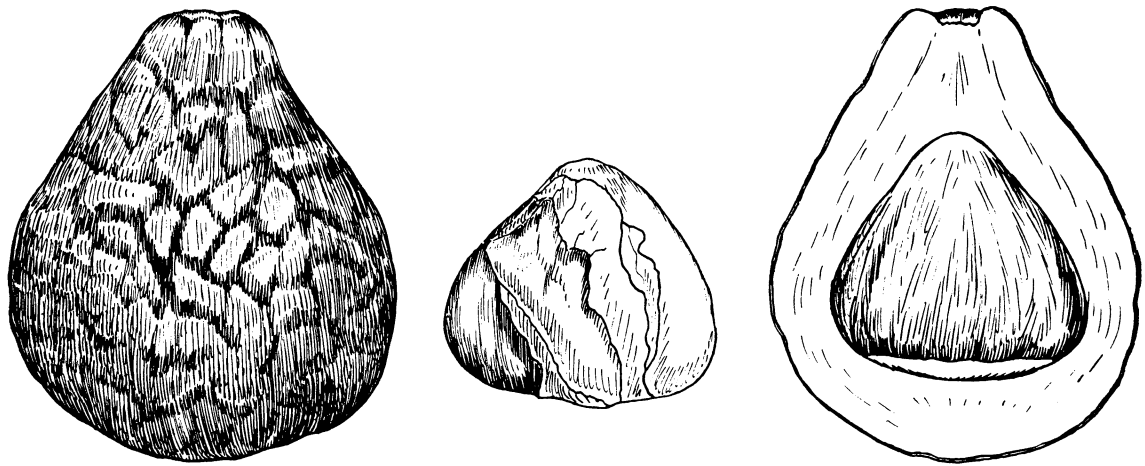


"WESTER" Avocado



"QUALITY" Avocado

"CARDINAL" Avocado



"VEGA" Avocado

regular bearer and the average annual yield for 4 years fruiting is 40 fruits; slightly attacked by wood borer; adapted to the soil and climatic conditions of Lamao, Bataan.

Quality.—Form obovate to pyriform, size small weight 290 to 560 grams; length $4\frac{5}{8}$ to $6\frac{1}{6}$ inches; greatest breadth $2\frac{3}{4}$ to $2\frac{15}{16}$ inches; base narrow, the slender stem 1 to $2\frac{1}{4}$ inches long inserted obliquely in a shallow flaring regular cavity; apex obliquely flattened or slightly depressed; surface smooth, glossy, greenish yellow color even when ripe with small maroon dots and few small brown spots; skin $\frac{3}{32}$ inch thick, adhering closely to the flesh; woody; flesh whitish yellow changing to yellowish green towards the skin, rather fibrous; good flavor; quality good; seed oblong conic, small to medium, fitting tightly in the cavity with the seed coats adhering closely. Season September.

Introduced from Fort Myers, Florida, in 1907; regular bearer and the average annual yield for 2 years fruiting is 43 fruits; slightly attacked by wood borer; adapted to the soil and climatic conditions of Lamao.

Cardinal.—Form obovate to pyriform, distincly necked; size medium large; weight 260 to 430 grams; length $5\frac{1}{4}$ to $6\frac{1}{4}$ inches; greatest breadth 3 to $3\frac{1}{4}$ inches; base narrow, stem $1\frac{3}{8}$ to $2\frac{1}{4}$ inches long inserted obliquely and flattened; surface moderately smooth, yellowish green in color before ripening but deep purple when ripe with small yellow dots; skin $\frac{1}{16}$ inch thick, separating easily from the flesh; flesh smooth and firm; color yellow changing to yellowish green near the skin, free from fiber discoloration; rich flavor; very good quality; seed broad, conic, small fitting tightly in the cavity with the seed-coats adhering closely. Season practically September.

Introduced from Coconut Grove, Florida, in 1907 and planted in the Lamao Experiment Station; irregular bearer and the average annual yield for 2 years fruiting is 23 fruits; the tree is attacked by wood borers and is seemingly not adapted to the soil and climatic conditions of Lamao.

Vega.—Form obovate to broad pyriform; not necked; size medium small, weight 270 to 480 grams, length $3\frac{7}{8}$ to $5\frac{1}{3}$ inches, greatest breadth $3\frac{1}{4}$ to $3\frac{5}{8}$ inches; base narrow, stem slender $1\frac{3}{4}$ to $2\frac{7}{8}$ inches long inserted obliquely in a medium deep regular flaring cavity; apex broadly rounded; surface undulating to rough but glossy, yellowish green in color before ripening and when ripe, having small yellowish dots; skin $\frac{3}{16}$ inch thick, separating readily from the flesh, coarsely granular,

brittle; flesh cream color, tinged with green toward the skin; few traces of fiber; rich flavor; good quality; seed almost perfectly heart shaped fitting tightly in the cavity with the seedcoats both adhering quite closely. Season September.

Introduced from Santiago de la Vega, Cuba, in 1906 and planted at the Lamao Experiment Station in 1915; regular but shy bearer; poor looking tree and attacked by wood borer.

Cummins.—Form roundish oblate; size small to medium; weight 200 to 400 grams; length $3\frac{1}{4}$ to $4\frac{1}{2}$ inches; greatest breadth $2\frac{3}{4}$ to $4\frac{1}{4}$ inches; base narrowing slightly, slightly oblique around the shallow rounded regular cavity in which the long stem ($2\frac{1}{2}$ to $5\frac{1}{4}$ inches long) is inserted; apex obliquely rounded; surface undulated to rough, slightly glossy, bright green to yellowish green but turned dark purple when ripe with yellow to russet dots; skin $\frac{1}{16}$ inch thick, firm, separating readily from the flesh; coarsely granular; flesh firm, greenish yellow to pale yellow, almost entirely free from fiber discoloration; good flavor; excellent quality; seed broad, conic, medium to medium large in size fitting tightly in the seed cavity with both seed coats adhering closely. Season September and October.

Introduced from the Hawaii Experiment Station, Honolulu, and planted in the Lamao Experiment Station in 1915; very shy and irregular bearer; the tree is healthy, though slightly attacked by borers; and is adapted to the soil and climate conditions of Lamao.

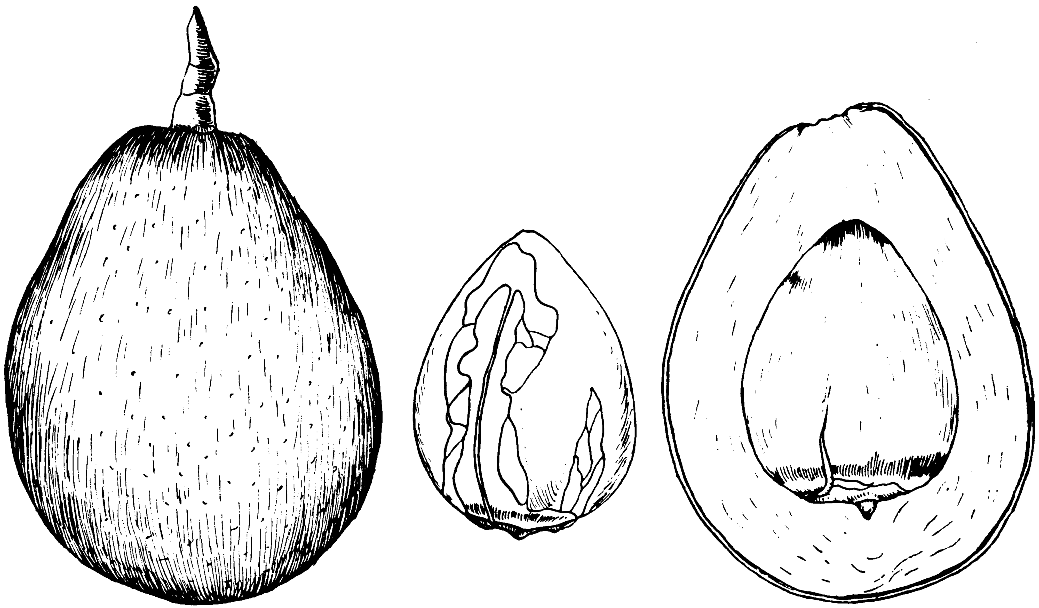
PESTS AND DISEASES

There are comparatively few insect pests and diseases which, at present affect the avocado in the Philippines. None of these, however, may be considered very serious. The proper control measures should always be sought whenever any pest or disease becomes serious. In the countries where the avocado has been grown for a long time, very serious insect pests and diseases are, of course, present.

PICKING

The avocado fruit should be picked when fully matured so that when it ripens its best flavor will develop. This stage is indicated by faint reddish streaks on the body of the fruit in such varieties which attain a dark purple color when ripe, and by a change to a lighter shade in those varieties whose fruit attains a yellowish green color when ripe. The grower will,

"CUMMINS" Avocado



AVOCADO No. 1

of course, recognize the right stage of maturity, after having had a little experience with the variety grown.

The fruit should be carefully cut off with a fruit cliper, leaving a very short stem attached. Rough handling easily injures the fruit. Therefore, the picker should always be careful not to bruise the fruit. In packing the fruits, each fruit should be wrapped individually with a clean paper, and transported in crates.

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THE INTRODUCTION OF DRY SEASON RICE CULTURE IN PANGASINAN BY THE ROSALES RICE SUB-STATION

By FRANCISCO P. OCTUPRE, *Assistant Agronomist In Charge, Rosales Rice Experiment Station*

As there are old irrigation systems in Pangasinan Province, the raising of rice during the dry season has long been thought of by the farmers in the region. This is specially true in the municipalities of Urdaneta, Tayug, Manaoag, Mangatarem and Umingan but the water has always been let go waste—allowed to run into the sea—during the dry season. It was in 1921 when the writter was asked by some farmers about the possibility of raising rice during the dry season in the province. They informed him of several attempts they had made and their failure to raise the dry season crops. They never believed for a moment that rice could be raised during the dry season in Pangasinan regions until they actually saw the results obtained from the following experiments conducted at the Rosales Rice Sub-Station and in the coöperative trial planting plots in the different irrigated forms under the management of the station.

PROCEDURE AND RESULTS OF EXPERIMENTS

In Pangasinan Province the irrigated farms are usually planted with rather late-maturing, bearded varieties of lowland rice, planted in June in seed beds, transplanted in July and harvested in December. The best time, therefore, to plant the dry season seed beds is in January, and to transplant in February then the crop will be ready to harvest in May or early in June. The object of these experiments was to find out three or more varieties of lowland rice that can be raised in the irrigated forms in Pangasinan regions. Several varieties of early maturing lowland rice were secured from Alabang Rice Experiment Station, Alabang, Rizal, and incorporated with some early maturing local rice varieties for the trial planting.

The method employed was similar to that for the regular wet-season planting of lowland palay. The seeds were first soaked in water for 24 hours and then set in the shade to germinate for another 24 hours. The seed beds were plowed and harrowed thoroughly and puddled just before planting the germinating seeds, which were broadcasted over the individual variety seed beds, which were properly labeled. The beds were irrigated just to the saturation point, during the first week, after

which time they were watered constantly with running water, until they were about 30 days old when they were big enough for transplanting. The permanent plots were also thoroughly prepared and each variety was planted in a variety plot of 100 square meters properly labeled for observation in the comparative test. The crop during the dry season required more attention than the regular crop during the rainy season. During the growing period, flowing water was constantly supplied to the plots in order to insure a normal crop, as if rice cannot be supplied with sufficient water it is stunted and gives poor yields. In low plots water must not be allowed to remain stagnant. It must be drained off once in a while. Small plantings are usually attacked by rice bugs and birds but the rice bugs can be got rid of by the methods explained in Bureau of Agriculture Circular No. 160. The most common birds that attack the dry season rice crop are the "mayas" which exist in flocks but can easily be controlled with traps and scarecrows.

Careful observations were made by the station personnel during the time the crop was growing to ascertain the varieties best adapted to dry season rice culture. The dates of planting, transplanting, heading, maturing and harvesting, the stooling capacity of each variety, the height or the crop at maturity, insect pests, resistance to drought and any other essential variety characteristics were carefully recorded. The following table is a compilation of the results obtained from the comparative test of the varieties submitted for trial planting during the period from 1921 to 1924 inclusive at the Rosales Rice Experiment Station:

Perm. No.	Variety name	Classification	Origin	Maturity days	Number of years tested	Yield per hectare	
						Kilos	Cavans
827	Sipot	L-wh-ng-nb.	Laguna	136	3	2,208	50
937	Binicol II	L-wh-ng-nb.	do	141	2	1,899	43
791	Sanglay	L-wh-ng-nb.	Zambales	131	2	1,849	42
1110	Mangasa	L-wh-ng-nb.	Nueva Ecija	130	4	1,684	38
990	Kaawa	L-wh-ng-nb.	Rizal	124	3	1,428	32
	Inita	L-wh-ng-nb.		124	2	1,561	35
993	Magsangle	L-wh-ng-nb.	Cavite	126	3	1,280	29
	Sinaryaya	L-wh-ng-nb.		128	3	1,152	26
924	Ryuchu	L-wh-ng-nb.	Formosa	129	3	1,627	37
263	Dinagat II	L-wh-ng-nb.	Batangas	128	3	1,393	32
	Lava	L-R-ng-nb.	Sumatra	132	2	1,248	28
	Lavasomatra	L-R-ng-nb.	do	132	1	1,357	31
	Balibod	L-wh-ng-nb.	Bulacan	129	2	1,515	37
695	Pinorsigue	U-wh-ng-nb.	do	125	2	1,295	29
968	Guinangan	L-wh-ng-nb.	Laguna	135	2	1,180	27
	Kinompopoy	L-wh-ng-nb.		126	1	1,470	33
989	Itani	L-wh-ng-nb.	Tarlac	130	1	670	15
1001	Apostol	L-wh-ng-nb.	Bureau of Agriculture	223	1	1,760	40
	Pinili	L.					

Sipot, a variety from Laguna Province, has been found to produce an average of 50 cavans of palay per hectare in a 3-year test and it is the favorite variety for dry season culture in Pangasinan. The varieties Binicol II and Sanglay have produced over 40 cavans per hectare in a 2-year test. There are six other varieties that produced over 30 cavans per hectare in 2- to 3-year test. Among the bearded local varieties Lampadan has proved so far the best adapted to dry season culture. The varieties Apostol and Pinili have produced over 40 cavans per hectare but they mature too late and are not therefore adapted to dry season culture. This experiment also shows that unless a farmer uses a variety adapted to dry season culture he is liable to fail to get a normal crop. In the Pangasinan rice regions, the varieties Sipot, Binicol II, Sanglay, Mangasa, Dinagat, and Lampadan are the six varieties of rice that can now be recommended for dry season culture.

Some of these varieties have been planted on a big scale at the station to secure seed rice. The following table shows the yield of some varieties in the propagation plots in the 1924 dry season rice culture experiment:

Perm. No.	Variety name	Area planted, sq. m.	Actual harvest in kilos	Yield per hectare	
				kilos	cavans
827	Sipot	1,000	222.1	2,281	52
924	Ryuchu	650	126.7	1,949	44
791	Sanglay	325	32.6	1,008	23
92	Binicol	250	35.8	1,420	33

In both comparative and propagation plots Sipot has shown the best results. The same variety has been propagated in the station for coöperative trial planting among the farmers in Pangasinan regions.

RESULTS OF THE EXPERIMENT EXTENDED TO FARMERS IN THE FORM OF COÖPERATIVE TRIAL PLANTING

It was in 1923, after two years work with dry season rice experiments, that the work of the Rosales Station began to show results among some few farmers in Pangasinan Province. Don Domingo Belesario, a wealthy farmer at Umingan, Pangasinan was the first to come pesonally to the experiment station for seed. Seed of eight varieties were given him for coöperative trial planting. His seeds were planted in the seeds beds on March 17, 1923, and the seedlings transplanted to the permanent plots on April 16-19, 1923. The crop had an excellent stand with which he was well satisfied. Among the eight varie-

ties given him for trial planting the Sipot and Mangasa gave the best results each having produce 35 and 31 cavans per hectare respectively although attacked by the birds.

The following year 12 more farmers secured seed palay from the station for coöperative trial planting during the dry season. They planted about 8 hectares to dry season rice in three different irrigated places in the province, with results as follows:

Coöperators and locations of plots	Variety planted	Area planted	Actual harvest	Yield per hectare	
				kilos	cavans
		Sq. m.	*Kilos*		
Rosales, Pangasinan					
Hacienda Esperanza	Sipot	2,240	308	1,380	31
Do	Mangasa	6,432	484	752	17
Urdaneta, Pangasinan	Sipot	2,200	318	1,445	17
Felipe Ambrucio	Mangasa.	6,600	969	1,466	33
Do.	Ryuchu.	2,100	220	1,047	24
Simeon Evangelista	Sipot	1,400	240	1,714	39
Do.	Mangasa.	2,080	132	633	14
Raymundo Peralta	Mangasa.	1,220	136	1,106	25
Luis Peralta	Ryuchu.	2,150	88	419	10
Leoncio Ambrucio	Mangasa.	2,500	138	552	13
Tomas Padilla	Sipot	620	88	1,458	33
Do.	Mangasa.	3,340	176	1,583	34
Do.	Ryuchu.	2,240	176	794	18
Manaog, Pangasinan Benigno Magno Soriano and four companions	Sipot Mangasa. Sanglay Ryuchu	In all about three hectares	21 cavans left over from birds	About ⅔ of the crop damaged by "maya" birds	

The best coöperative plots in 1924 were in Barrio Bactad in Urdaneta where they raised over 33 cavans per hectare even after the fields were attacked by rice bugs. The crops, specially Sipot, had a very good stand. In Manaoag the crops were also good.

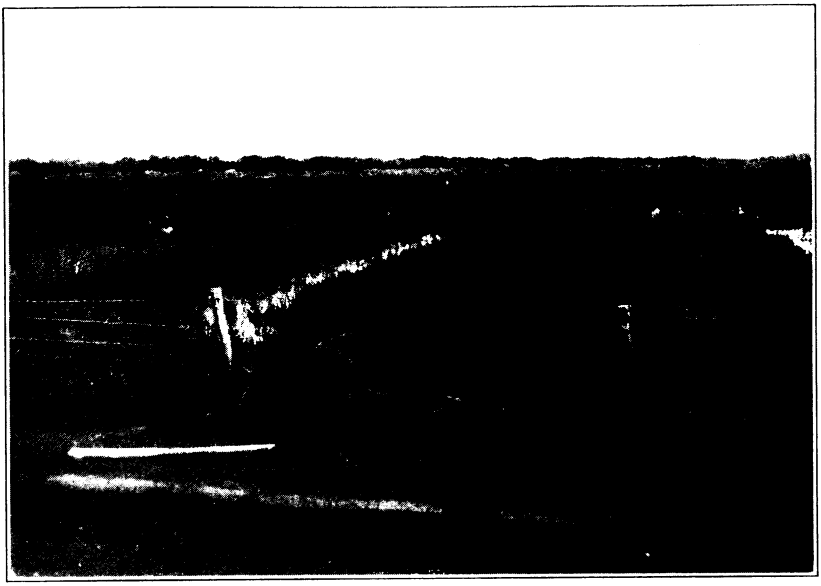
In 1925 the number of station coöperators increased to 28 and an area of about 20 hectares was planted to dry season rice. In Umingan there were about 12 hectares planted, in Manaoag 5 hectares and in the municipalities of Tayug and San Nicolas about 3 hectares. The following were the results obtained from some of the coöperative plots in 1925:

Coöperators and location of plots	Area planted	Actual harvest	Yield per hectar	Remarks
Tayug, Pangasinan:	*Sq. m.*	*Cavans*	*Cavans*	
Macario Lechauco	9,066.0	19.0	21.0	Partly damaged by "maya" birds.
Marcelino Baniqued	2,842.0	16.0	56.3	Good crop.
Manaoag, Pangasinan:				
Leonardo Torralba	9,391.9	40.5	43.1	Do.
Alejandro Agbalog	6,960.3	30.5	43.8	Good stand.
Daniel Espresion	6,905.7	25.0	36.2	Good crop.
Alejandro Leal	2,748.6	6.6	27.2	Affected by flood.
Esteban Gutang	7,062.5	15.0	21.0	Do.
Anatalio Madera	1,750.0	3.0	17.1	Do.
Sotero Locero	6,309.2	6.0	9.5	Do.

NOTE.—One cavan of palay weighs 44 kilos. Variety used, Sipot.

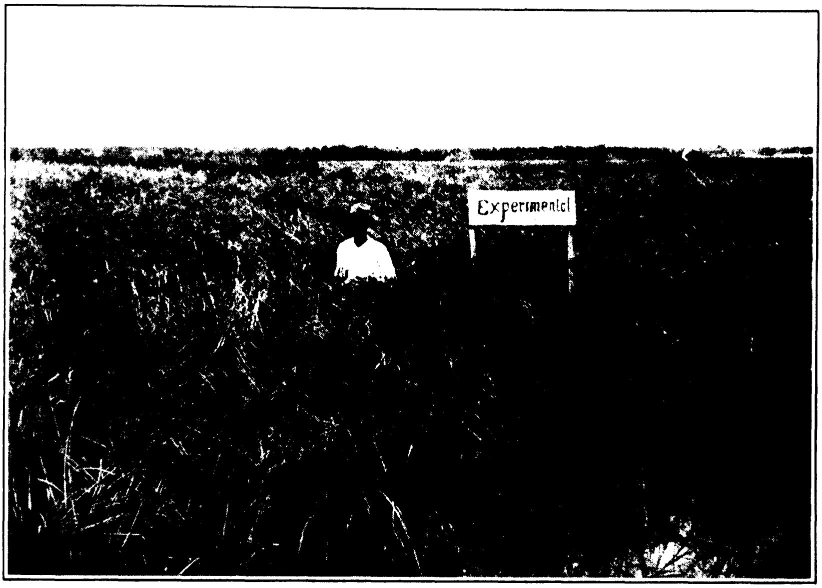
In 1925 the best results were obtained in the coöperative plots in Tayug, Pangasinan, by Mr. Marcelino Baniqued, who produced a crop at the rate of 56.3 cavans of palay per hectare, as per measurements made by Mr. Isidoro Balanay, assistant agricultural extension agent in charge of Pangasinan. And in Manaoag there were several coöperators who produced over 40 cavans per hectare. In Umingan where the coöperators adopted the broadcasting method, their crops were overcrowded with weeds and did not succeed very well. The coöperators decided to repeat the trial planting but by the transplanting methods.

During the three previous years there had been all sorts of difficulties in connection with the coöperative trial planting work with the dry season rice. These difficulties, however, served as a basis for study to discover better methods of dry season rice culture in the Pangasinan regions, where the soil is still rich but where the weeds grow so fast than before. Nearly all of the coöperative plots in the dry season rice culture in Pangasinan regions were attacked by the rice bugs and "maya" birds because they were usually planted in small patches far apart from each other in the irrigated farms. Only extensive cultivation of dry season rice will remedy this. In the Barrio Santa Ines in Manaoag a fine crop was damaged by the floods. This would not have happened had it not been planted too late. Planting the rice at the proper time, i. e., in January, will usually make it possible to harvest it before the floods come at the beginning of the rainy season.



(a) B. A. Photograph No. 6891.) Dry season rice comparative experimental plots at Rosales Rice Experiment Station.

(b) (B. A. Photograph No. 6893). Irrigation dry season crop from canals at Rosales Rice Experiment Station.

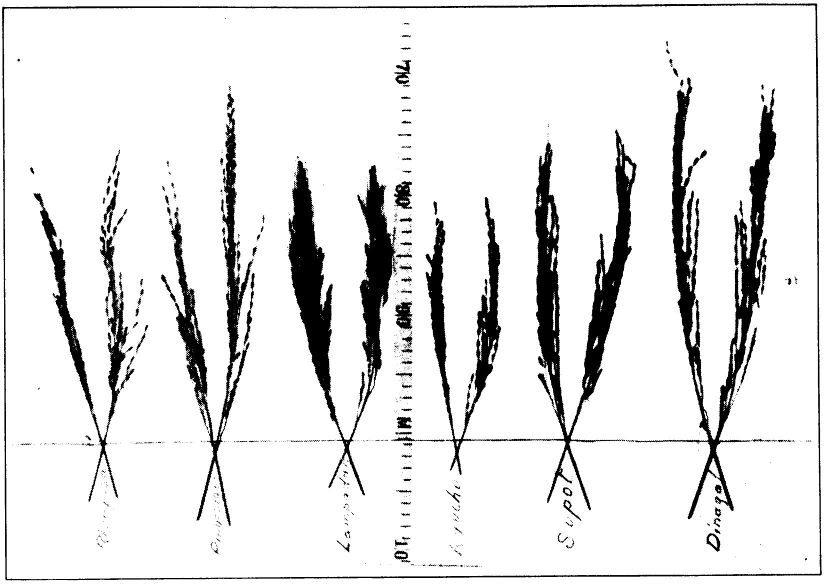


(*a*) (B. A. Photograph No. 6892). Heavy Sipot dry season crop in the propagation plots at Rosales Rice Experiment Station.

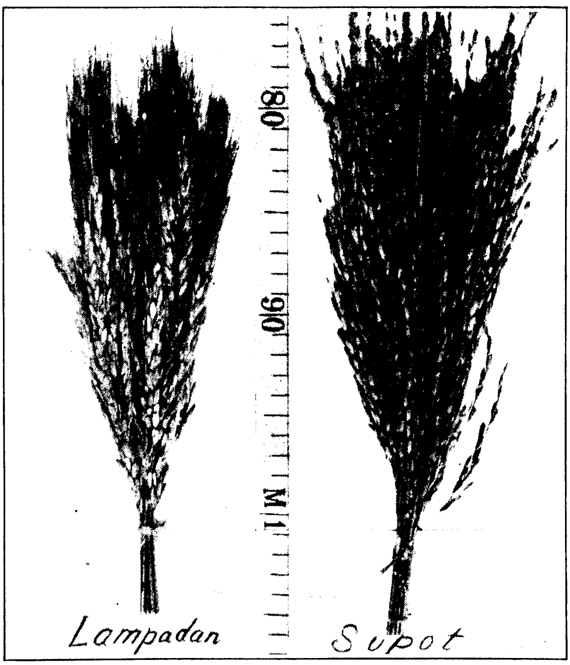
(*b*) (B. A. Photograph No. 7625). Lodging dry season rice crop at the propagation plots at Rosales Rice Experiment Station.

(*a*) (B. A. Photograph No. 6898). Sipot individual plants, two best nonbearded varieties of dry season rice produced from experimental plots at Rosales Rice Experiment Station.

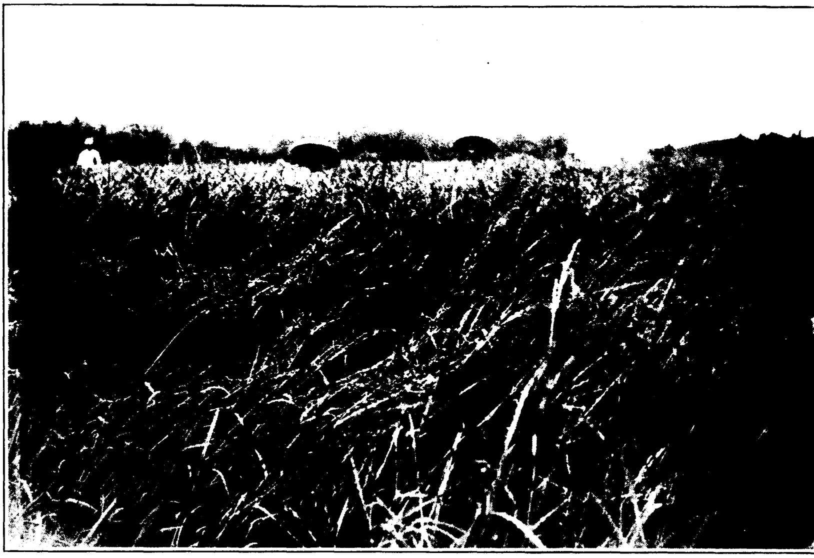
(*b*) (B. A. Photograph No. 6899). Lampadan and Saigorot dry season rice individual plants, two bearded varieties produced from experimental plot at Rosales Rice Experiment Station.



(*a*) (B. A. Photograph No. 6895). Types of rice heads produced from dry season rice variety test plots at Rosales Rice Experiment Station.



(*b*) B. A. Photograph No. 6894). Panicles of Sipot and Lampadan both best varieties of dry season rice showing their full grains produced from Rosales Rice Experiment Station.



(*a*) Coöperator Don Domingo Belisario and his dry season rice crop at Umingan, Pangasinan, 1922.

(*b*) Coöperator Don Felipe Ambrocio and his Sipot dry season crop in the coöperative plots in Urdaneta, Pangasinan, in 1924. (B. A. Photograph No. 7619.)

SUGAR-CANE VARIETY TESTS OF THE BUREAU OF AGRICULTURE

Since 1905 the Bureau of Agriculture has been introducing, acclimatizing and testing exotic and native sugar-cane varieties with the aim of increasing the production of this crop both in tonnage of cane and in sucrose content under different (including adverse) soil and climatic conditions in the Philippines. Some of the most promising varieties are as follows:

Badila or New Guinea–15.—A variety introduced into the Philippines from Australia. It has an erect habit and 3 to 8 millable stalks per stool each from .98 to 1.74 meters long, 2.5 to 4.5 centimeters in diameter and weighing from 1.3 to 3.2 kilos. The color is light to dark purple. The internodes are short rather than long; staggered; and tapering at one end. The tissue is white. The epidermis cracks. The root band has sparse root dots arranged in 3 rows. The glaucous band is heavily covered with conspicuous bloom. The buds are large, triangular in shape and develop on the stalk. The leaves are light green, medium to broad in width and broadly lanceolated in outline. The leaf sheath is provided with persistent stiff hairs on the back. The collar is pallid and lannate. The dried leaves fall off leaving the cane clean. It arrows very freely generally in the months of November and December. The canes mature in about 12 months or 367 days but the highest sugar content is attained when they are about 13 or 14 months old.

This variety has an excellent ratooning power and has been observed to be highly resistant to the mosaic and fiji diseases and probably is to sugar-cane smut too. It is recommended for planting on newly opened land where the soil is very fertile.

Barbados–147.—A variety introduced into the Philippines from Australia. The plant has a recumbent habit and 2 to 9 millable stalks per stool each from 1.17 to 1.85 meters long, 2.0 to 3.8 centimeters in diameter and weighing from 1.04 to 2.0 kilos. The color is greenish red with a purplish tint. The internodes are medium in length; staggered; and cylindrical in shape. The tissue is yellowish and soft in texture and especially good to chew. The epidermis does not crack. The root band has sparse

root dots generally arranged in 3 rows. The glaucous band is heavily covered with conspicuous bloom. The buds are of medium size, ovate in shape and quite dormant on the stalk. The leaves are light green in color, medium to broad in width and broadly lanceolated in outline. The leaf sheath is provided with stiff hairs on the back but are deciduous. The collar is dark brown and lannate. It produces arrows generally in the months of November and December. The cane matures in about 11 months or 336 days.

This variety has a good ratooning power and is but slightly affected by mosaic, fiji, and smut diseases of sugar cane.

Goru or New Guinea–24.—A variety introduced from Australia. The plant has rather a recumbent habit and 2 to 8 millable stalks per stool each from 1.22 to 2.38 meters long, 1.9 to 3.4 centimeters in diameter and weighing from about 1.04 to 1.8 kilos. The color is copperish and sometimes much like that of Barbados. The internodes are medium in length; staggered; and slightly tapering toward the base. The tissue is yellowish and very soft in texture and so is very good to chew. The epidermis cracks. The root band has numerous well developed root dots arranged generally in 4 rows. The glaucous band is heavily covered with bloom and the color blends with that of the internode. The buds are large, ovate in shape and do not develop readily on the stalk. The leaves are light green in color, broad in width and broadly lanceolated in outline. The leaf sheath is provided with persistent stiff hairs on the back. The collar is pallid and lannate. It produces arrows in the months of November and December. The cane matures in about 11 months or 337 days but the highest sugar content is attained when the crop is 12 months old.

This variety has also a good ratooning power and is but slightly susceptible to mosaic, fiji, and probably smut also.

Java–247.—A variety introduced into the Philippines from Java. The plant has a suberect habit and 5 to 10 millable stalks per stool, each from 1.02 to 2.85 meters long, 1.8 to 3.5 centimeters in diameter and weighing from 0.94 to 1.90 kilos. The color is vinaceous purple. The internodes are long; slightly staggered; and cylindrical in shape. The tissue is white and quite hard in texture. The epidermis cracks. The root band has numerous root dots scattered indiscriminately. The glaucous band is heavily covered with bloom and the color blends with that of the internode. The buds are small, ovate in shape and dormant on the stalk. The leaves are green in color, medium in

width and broadly lanceolated in outline. The leaf sheath is provided with deciduous stiff hairs on the back. The collar is pallid and glaucous. The leaves are shed also. The arrows appear at the same time with Barbados–147 in the months of November and December. The canes mature in about 12 months or 365 days.

This variety has a fairly good ratooning power and is slightly susceptible to mosaic but not fiji nor smut has been observed on it.

New Guinea 24–A.—A variety introduced from Australia. Has a recumbent habit and 2 to 11 millable stalks per stool each from 1.22 to 2.4 meters long, 2.5 to 3.2 centimeters in diameter and weighing from 0.88 to 1.47 kilos. The color is mustard yellow. The internodes are medium in length, straight and tapering at one end. The tissue is white and medium in texture. The epidermis does not crack. The root band has numerous root dots scattered indiscriminately over it. The glaucous band is slightly covered with bloom and the color merges in that of the internode. The buds are of medium size, orbicular in shape and usually dormant on the stalk. The leaves are pale green in color, wide and broadly lanceolated in outline. The leaf sheath is provided with stiff deciduous hairs on the back. The collar is dark brown. The leaves are not very resistant on the stalk. The arrows appear in the months of November and December. The canes mature in about 13 months or 397 days, but may, however, be harvested even when but 12 months old.

The variety ratoons very well and has been found highly resistant to the mosaic and so far immune to fiji and smut. It seems to do well in any kind of soil where other varieties of sugar cane will grow. It is adapted for milling in small muscovado mills as well as in the centrals.

New Guinea 24–B.—This is another variety introduced from Australia. The plant has a suberect habit and 3 to 8 millable stalks per stool each from 1.19 to 2.16 meters long, 2.5 to 4.0 centimeters in diameter and weighing from 1.1 to 2.05 kilos. The color is pyrite yellow. The internodes are medium in length; staggered; and cylindrical in shape. The tissue is yellowish and medium in texture. The epidermis cracks. The root band has numerous root dots arranged generally in 3 rows. The glaucous band is heavily covered with bloom but blends in color with that of the internode. The buds are small, ovate in shape and develop on the stalk. The leaves are dark green, broad and broadly lanceolated in outline. The leaf sheath is provided with

stiff deciduous hairs on the back. The collar is pallid and lannate. The leaves are not so persistent on the stalk. The arrows appear in November and December. The canes mature in about 11 months or 350 days, earlier than New Guinea 24–A.

This variety ratoons very well and is highly resistant to mosaic and apparently immune to fiji and smut.

Hambledon 426.—Another variety introduced from Australia. The plant has a suberect habit and about 2 to 7 millable stalks each from 1.17 to 2.14 meters long, 2.0 to 3.5 centimeters in diameter and weighing from 0.9 to 1.16 kilos. The color is ox blood red with greenish shading. The internodes are rather short; staggered; and cylindrical in shape. The tissue is white and soft. The epidermis cracks. The root band has sparse root dots arranged in 3 rows. The glaucous band is heavily covered with bloom. The buds are small, orbicular in shape and dormant on the stalk. The leaves are very green, medium in width and narrowly lanceolated in outline. The leaf sheath is not provided with stiff hairs on the back. The collar is dark brown and lannate. The leaves are quite persistent on the stalk. The arrows generally appear in November and December. The canes mature in about 12 months or 363 days.

This variety has a fair ratooning power. It has been observed to be slightly infected with mosaic but not with fiji nor smut.

Hawaii–109.—This variety was introduced from Hawaii, and is a hybrid between the Lahaina and the Hawaii–146. The plant has an inclined to recumbent habit and 5 to 9 millable stalks per stool from 1.9 to 3.2 meters long, 3 to 4.5 centimeters in diameter and weighing 1.69 to 3.6 kilos. The color is greenish red. The internodes are long, straight and cylindrical in shape. The tissue is white and medium in texture. The epidermis does not crack. The root band has sparse root dots arranged generally in 2 rows. The glaucous band has abundant bloom which gives a dirty appearance to the stalk. The buds are small, triangular in shape and develop on the stalk. The leaves are deep green in color, medium in width and broadly lanceolated in outline. The leaf sheath has persistent stiff hairs on the back. The collar is pallid and glaucous. The arrows appear in the months of November and December. The canes mature in about 14 months.

The variety has an excellent ratooning power but it is very susceptible to fiji disease though not to mosaic and probably not to smut.

The results in brief from our variety tests for the last four years at our La Carlota Sugar Cane Experiment Station, Occidental Negros, are as follows:

(1) NEW GUINEA 24-A

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectar: Tons of cane	Yield per hectar: Piculs of sugar
1923-1924	11.4	19.1	17.1	89.0	13.13	2.07	71.20	147.38
1924-1925	8.4	17.1	14.9	87.1	11.56	1.83	83.35	152.53
1925-1926	10.4	16.9	13.7	81.0	9.32	1.47	102.67	151.18
1926-1927	9.6	16.3	13.4	82.2	9.13	1.44	78.92	113.48
Total	39.8	69.4	59.1	339.3	43.14	6.81	336.14	564.57
Average	10.0	17.4	14.8	84.8	10.79	1.70	84.04	141.14

(2) HAWAII-109

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectar: Tons of cane	Yield per hectar: Piculs of sugar
1923-1924	10.8	18.9	15.6	82.5	11.44	1.80	87.46	157.43
1924-1925	11.3	12.2	12.1	79.7	8.97	1.42	83.83	119.04
1925-1926	10.3	16.2	13.4	83.0	9.77	1.54	110.44	170.65
1926-1927	8.9	17.7	14.6	82.3	10.82	1.71	62.42	105.43
Total	41.3	65.0	55.7	327.5	41.00	6.47	344.15	552.55
Average	10.3	16.3	13.9	81.9	10.25	1.62	86.04	138.14

(3) BADILA

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectar: Tons of cane	Yield per hectar: Piculs of sugar
1923-1924	9.7	19.3	17.0	88.4	13.31	2.10	78.80	165.48
1924-1925	10.8	17.6	15.0	85.2	11.61	1.83	66.36	121.42
1925-1926	9.8	17.7	15.7	88.7	11.78	1.86	72.04	134.19
1926-1927	10.0	19.8	17.4	87.3	13.12	2.07	62.62	129.86
Total	40.3	74.4	65.1	350.0	49.82	7.86	279.82	550.95
Average	10.1	18.6	16.3	87.5	12.46	1.97	69.96	137.74

(4) JAVA-247

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectar: Tons of cane	Yield per hectar: Piculs of sugar
1923-1924	13.4	20.2	16.5	81.7	11.72	1.85	55.04	101.82
1924-1925	7.4	14.7	11.3	76.9	8.33	1.31	83.45	109.32
1925-1926	10.1	15.5	12.6	80.8	9.00	1.42	105.78	150.27
1926-1927	9.9	18.6	15.7	84.1	11.67	1.84	82.45	151.23
Total	40.8	69.0	56.1	323.5	40.72	6.42	326.72	512.64
Average	10.2	17.3	14.0	80.9	10.18	1.61	81.68	128.16

(5) BARRADOS

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectar: Tons of cane	Yield per hectar: Piculs of sugar
1923-1924	11.6	20.1	17.1	85.1	12.79	2.02	51.34	103.70
1924-1925	12.4	16.1	12.6	78.3	9.06	1.44	75.45	108.65
1925-1926	9.8	16.8	14.4	85.7	10.63	1.68	90.80	149.99
1926-1927	9.5	16.5	13.9	84.2	10.28	1.62	58.37	94.76
Total	43.3	69.5	58.0	333.3	42.76	6.76	275.96	457.10
Average	10.8	17.4	14.5	83.3	10.69	1.69	68.99	114.28

(6) ROSE BAMBOO

Year	Per cent fiber cane	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectare	
							Tons of cane	Piculs of sugar
1923-1924	8.9	19.5	17.4	89.2	13.84	2.18	47.30	103.11
1924-1925	12.3	15.1	12.6	83.5	9.65	1.53	73.17	111.95
1925-1926	9.7	14.8	12.2	82.8	8.40	1.32	89.68	117.95
1926-1927	8.6	16.9	14.3	84.4	10.66	1.68	66.40	111.85
Total	39.5	66.3	56.5	339.9	42.55	6.71	276.55	444.86
Average	9.9	16.6	14.1	85.0	10.64	1.68	69.14	111.22

(7) NEW GUINEA 24-B

1923-1924	11.9	17.8	15.2	85.4	11.30	1.82	52.07	94.76
1924-1925	8.2	17.7	15.9	89.9	12.84	2.02	66.33	133.99
1925-1926	10.4	15.2	12.3	80.9	8.79	1.38	63.60	87.85
1926-1927	9.0	17.0	13.4	79.4	9.61	1.52	56.30	85.67
Total	39.5	67.7	56.8	335.6	42.54	6.74	238.30	402.27
Average	9.9	16.9	14.2	83.9	10.64	1.69	59.58	100.57

(8) YELLOW CALENDONIA

1923-1924	10.4	18.5	15.1	79.4	10.51	1.67	84.19	107.19
1924-1925	12.6	15.7	12.6	80.3	9.89	1.48	48.13	71.23
1925-1926	10.6	17.0	13.9	81.8	9.99	1.57	75.40	118.70
1926-1927	9.0	17.3	13.7	79.2	9.92	1.51	77.01	116.30
Total	42.6	68.5	55.3	320.7	39.81	6.23	284.73	413.42
Average	10.7	17.1	13.8	80.2	9.95	1.56	71.18	103.36

(9) NEGROS PURPLE

1923-1924	10.3	18.4	16.4	89.1	12.66	1.99	48.55	96.85
1924-1925	11.3	15.5	12.5	80.7	9.38	1.48	63.99	94.03
1925-1926	8.5	15.5	13.0	83.4	9.53	1.51	75.84	114.52
1926-1927	9.0	17.6	14.7	83.2	10.84	1.72	59.69	101.70
Total	39.1	67.0	56.6	336.4	42.41	6.70	248.07	407.10
Average	9.8	16.8	14.2	84.1	10.60	1.68	62.02	101.78

(10) HAMBLEDON-426

1923-1924	10.4	16.1	14.0	87.0	10.87	1.72	47.20	81.18
1924-1925	10.2	17.4	13.6	78.2	9.89	1.56	71.58	111.66
1925-1926	10.7	17.4	15.4	86.8	11.22	1.76	67.03	116.89
1926-1927	8.5	16.2	13.2	81.1	9.42	1.49	58.02	89.15
Total	39.8	67.1	55.9	333.1	41.40	6.53	243.83	398.88
Average	10.0	16.8	14.0	83.3	10.35	1.63	60.96	99.72

(11) LOUISIANA STRIPED

1923-1924	11.3	19.4	16.9	85.5	12.72	2.01	46.57	93.60
1924-1925	9.2	18.1	15.2	83.9	11.73	1.85	51.11	94.55
1925-1926	10.2	14.8	11.4	77.8	8.00	1.26	80.86	101.75
1926-1927	9.5	18.2	15.5	85.2	11.60	8.81	55.51	101.48
Total	40.2	70.5	59.0	332.4	44.05	6.95	234.05	391.38
Average	10.1	17.6	14.8	83.1	11.01	1.74	58.51	97.85

(12) LUZON WHITE

Year	Per cent fiber (cane)	Brix (juice)	Per cent polarization (juice)	Apparent purity (juice)	Per cent sugar cane	Piculs per ton cane	Yield per hectare: Tons of cane	Yield per hectare: Piculs of sugar
1923-1924	11.3	18.3	15.1	82.5	11.09	1.75	56.07	98.12
1924-1925	7.0	14.2	11.8	83.1	9.00	1.42	74.45	105.72
1925-1926	9.7	15.4	12.6	81.7	9.07	1.43	67.93	97.15
1926-1927	9.6	16.6	13.5	81.4	9.92	1.57	57.92	90.29
Total	37.6	64.5	53.0	328.7	39.08	6.17	256.37	391.28
Average	9.4	16.1	13.3	82.2	9.77	1.54	64.09	97.28

(13) LUZON PURPLE

1923-1924	10.8	16.9	13.4	79.4	9.62	1.51	39.22	59.22
1924-1925	11.4	14.8	12.5	84.5	9.60	1.51	63.97	96.59
1925-1926	9.8	16.4	13.7	83.9	9.96	1.57	74.22	116.95
1926-1927	9.8	17.4	14.5	83.5	10.79	1.70	68.66	115.67
Total	41.9	65.5	54.1	331.3	39.97	6.29	246.07	388.43
Average	10.5	16.4	13.5	82.8	9.99	1.57	61.52	97.11

(14) GORU OR NEW GUINEA-24

1923-1924	11.3	19.4	16.8	85.6	12.52	1.98	45.10	89.29
1924-1925	9.4	15.7	12.1	77.1	8.60	1.36	67.19	91.38
1925-1926	10.5	16.3	13.5	82.7	9.72	1.53	74.94	115.12
1926-1927	8.6	17.1	13.8	80.7	10.04	1.59	56.48	89.74
Total	39.8	68.5	56.2	326.1	40.88	6.46	243.71	385.53
Average	10.0	17.1	14.1	81.5	10.22	1.62	60.93	96.38

(15) BIG TANNA-3525

1923-1924	12.0	15.0	10.6	70.7	5.58	.88	55.40	48.75
1924-1925	10.7	13.7	10.5	78.5	7.71	1.22	71.63	87.39
1925-1926	10.3	13.4	9.4	70.1	6.15	.97	80.34	77.93
1926-1927	9.8	16.8	12.5	73.9	8.70	1.37	76.42	102.63
Total	42.8	58.9	43.0	293.2	28.14	4.44	283.79	316.70
Average	10.7	14.7	10.8	73.3	7.04	1.11	70.95	79.18

Notwithstanding the fact that years ago the only recognized good sugar-cane varieties in the Philippines were Negros Purple, Luzon White, and Luzon Purple, the Bureau of Agriculture through variety tests has found for the sugar planters 13 promising exotic varieties, viz.: New Guinea 24–A, Hawaii–109, Badila, Barbados, Barbados–147, Java–247, Rose Bamboo, Hambledon–426, New Guinea 24–B,, Yellow Caledonia, Goru or New Guinea–24, Louisiana Striped, and Big Tanna–3525. They are capable of producing 70.95 tons of cane with 79.18 piculs of sugar per hectare to 84.04 tons of cane to 141.14 piculs of sugar. It has been found that Badila is good for planting on newly opened fertile land and that New Guinea 24–A does well in any kind of soil and is adapted to small mills and centrals. Hawaii–109 is widely grown in Isabela, Occidental Negros, as it gives a satis-

factory yield of cane and juice at the age of 14 months. Barbados is soft and specially adapted to places where the demand for chewing cane is great. Rose Bamboo is the popular Cristalina of Cuba giving a satisfactory yield of cane, juice, and fiber. New Guinea 24–B compares favorably witn Badila. Java–247 and Louisiana Striped are fairly good yielding varieties. Yellow Caledonia and Big Tanna–3525 produce big and hard canes adapted only to the centrals. Goru or New Guinea–24 is remarkably sweet, has long internodes and is good for muscovado manufacture.

THE HUNDRED ISLANDS

By Paul Villyar
Assistant Agronomist

The Hundred Islands consist of a group of islands and islets numbering more than one hundred lying east of Alaminos municipality and halfway between Ratiarao and Encarnada points. They are locally named "Kapulupuluan," meaning group of islands. Apparently not all are named at all. The few that have names are "Nagcarbonan" (old charcoal manufacturing place), "Sulpot" (shaped like a bag), "Camantilis" (producing camanchile trees) and the "Mayola" (having a cave that can be entered at low tide). At a rough estimate they contain about 250 hectares.

TOPOGRAPHY AND SOIL

The majority of the islands are more or less hilly. They are irregular in shape and in size, the smallest islet containing about five square meters and the largest some ten or twelve hectares perhaps. Every one of the group when observed from the sea at close range appears to be a massive rock with a perforated surface. The disintegration of the rocks together with the decay of organic matter has produced a fertile soil, as witness the amazingly luxuriant vegetation covering the islands. The soil varies from barely one centimeter in depth, yet capable of supporting plant life like the pretty begonia, to three meters or more yielding useful fruit and timber, like the mango and molave.

HOW REACHED

They are about 301 kilometers from Manila via Alaminos and can be reached any day and any time regardless of weather conditions by taking a train from Manila to Dagupan and from there motoring over a first-class road to Alaminos, and thence either in auto or calesa over a second-class road of 5 kilometers to Lucap port, where a boat can be hired to the islands. Boats can also go there from Lingayen, Dagupan, San Fabian, Damortis, Bauang or San Fernando under favorable weather conditions, and small steamers can approach the islands by two channels about 10 fathoms deep.

PRODUCTS

Agriculturally speaking, the Hundred Islands produce an insignificant quantity of maguey, corn, and vegetables on very small clearings. The people of Alaminos being prosperous, peaceful, and happy as a whole, and having more land than they can easily farm do not take the trouble to settle on the One Hundred Islands. They are 15,543 in number and inhabit a municipality comprising 16,000 hectares. They go to the Islands to cut wood for timber or for fuel or to get guano from the caves or the fertile loam soil from the islands to fertilize their farms. Others go fishing there by day or by night, in the sheltered waters surrounding the islands.

FLORA

The flora of the Hundred Islands is most alluring to the agriculturist, and between the islands are found most interesting marine plants varying in size and shape from 1 centimeter to over 1 meter long and from dull to bright colors. Among them are algae said to contain 15 to 30 per cent potash. Pteridophyta are represented by ferns that do not seem to be plentiful in the larger islands. Herbs, vines, shrubs and trees like the luya-luya, cogon, and begonia, moonflower, guava, alagao, mango, tamarind and camanchile, dungon and molave are among the spermatophyta. Such plant forms are of common occurrence in the larger islands.

FAUNA

There is abundadant animal life in and about the Hundred Islands, as for example seaworms and earthworms representing the annelids; shrimps, the arthropods; ants, flies, butterflies and dragon flies, the insects; beehives, the mollusca; starfish and sea urchins, the echimoderms; groupers, basses, milk fish, anchovies, herrings, silversides, mackerel, snappers and their allies, the fishes; snakes and lizards, the reptilla; singing birds, sparrows and ducks, the birds; and bats, wild pigs and monkeys, the mammals.

THEIR POTENTIAL RESOURCES

The fact that fruit trees, like the mango, tamarind, guava and camanchile grow wild under the soil and climatic conditions of the Hundred Islands points out the possibility of growing there such fruit trees and similar ones on a commercial basis. The soil of the large islands is very rich and if it should become depleted from overcropping, it could be fertilized with ground

starfish which abound and are said to contain about 4 per cent of nitrogen and 6 per cent of phosporic acid, together with the algae found in the same locality supposed to provide 15 to 30 per cent potash. Besides fruit, valuable timber from molave, dungon and other related species could be grown profitably. Fair representative specimens of these trees are found in the thickest part of the jungle covering the islands.

Considering the occurrence of wild pigs and ducks on the islands, the raising of swine, goats and poultry is very possible provided their feeds are furnished. These could be raised locally since good crops of corn, tubers and vegetables have been repeatedly grown on clearings made for the purpose.

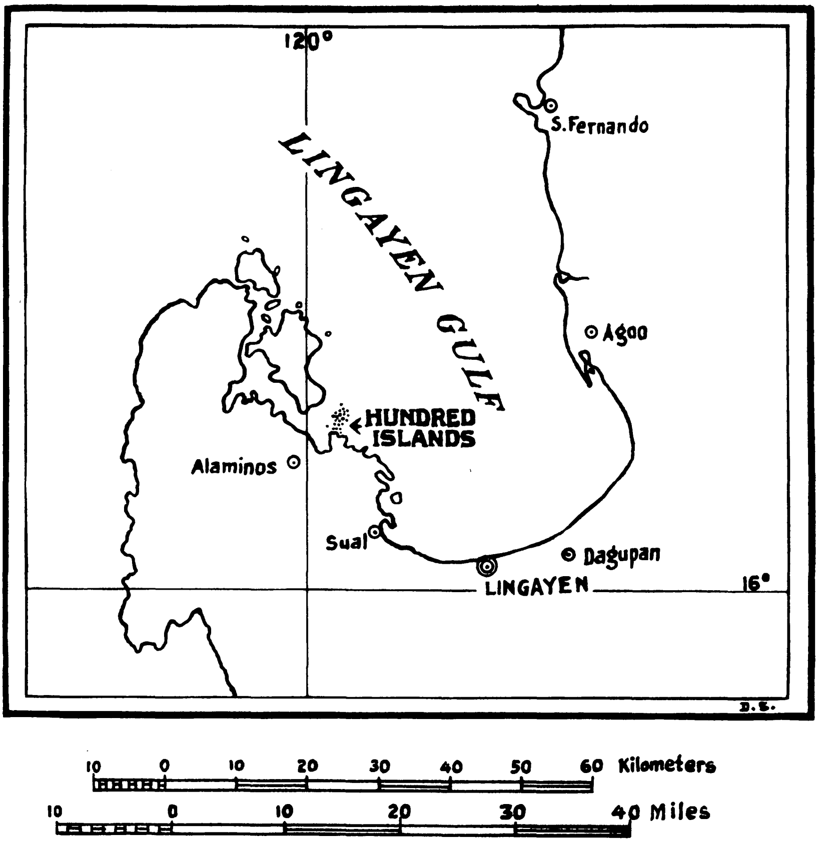
Areca and coconut palms might be planted and these with the guava trees and other nectar-producing plants on certain islands in the western portion of the group would furnish an ample supply of nectar throughout the year for honey bees. Hence, certain islands could be converted into appiaries. Three islands belonging to the group but very close to the western shore of Luzon Island recently were connected with it artificially and are now producing coconut trees.

AS NATIONAL AQUARIUM SITE

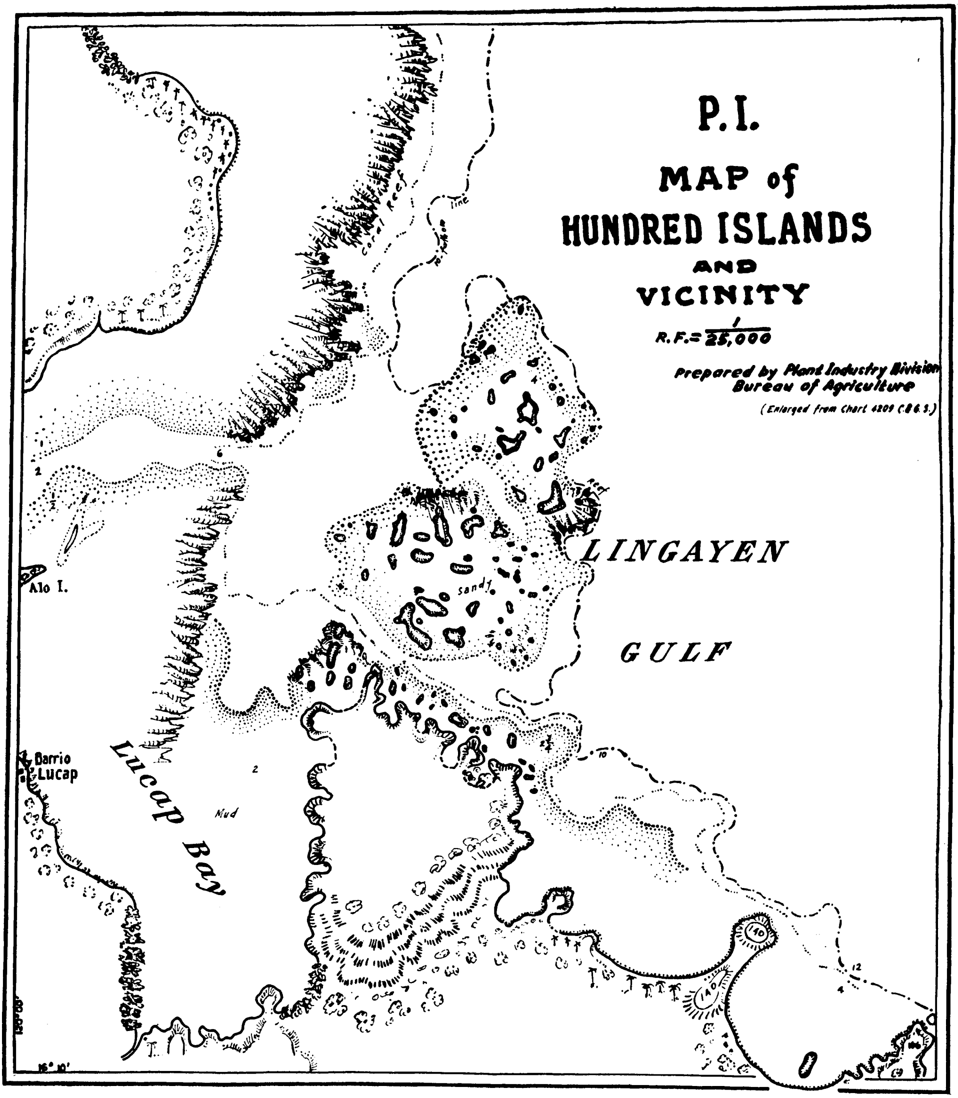
The accessibility of this group of islands, the absence of big rivers to empty into the sea there to drive out marine flora and fauna, the natural aëration of water among them brought about by the current from the Caquiputan Strait during high tide preventing stagnation, the hardness of their rocky bases, the abundance of the flora and fauna about them and the capability of their soil to produce food, clothing, shelter and fuel for human being, are favorable factors for the Government to consider in establishing a national aquarium at the One Hundred Islands.

PRESENT VISITORS

It has been reported that scientists visit the islands from time to time for biological studies and that professional people go there also camping for vacation, amusing themselves by hunting and fishing.



Showing the location of the Hundred Islands



Map of the hundred islands

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"TURNUHAN" AS PRACTISED IN VARIOUS PROVINCES

COMPILED BY

JULIAN C. BALMACEDA,
Acting Chief, Rural Credit Division

INTRODUCTION

In the Philippines labor in common is often placed upon a permanent basis of reciprocity into which the elements of lottery, insurance, and even banking may enter.

These associations are most widely distributed in connection with village agricultural activities such as plowing, planting, harvesting, threshing, and the like.

The Tagalog name for these associations is "Turnuhan," derived from the Spanish word "turno," meaning turn. These "turnuhans" are most perfected in the highland portion of Laguna Province, a very democratic part of the Philippines where by reason of recent settlement practically every farmer owns the land he cultivates.

In this region the "turnuhans" are often regularly organized with elected officials and constitutions. The most advanced forms deal with house building; each member subscribes a certain amount once a month and each month the lot is drawn which determines the lucky member who receives the total subscriptions for that month. With this money he builds a house. No member can draw more than once, and hence, the lottery feature only determines the sequence in which the members shall receive the total monthly subscriptions.

In all "turnuhans" system of fines protects the members against defaults.

The rights accruing to a lot are salable; for instance, the town of Cavinti, Laguna, once bought from the lucky member the services of the members of his "turnuhan" in order to level a knoll for school site.

One of the most interesting forms of the "turnuhan" system is that relating to the production of craft articles in the household. An example may be taken from Cavinti, Laguna Province, where the people have an extensive household industry for the manufacture of hats. Several hat-making "turnuhans" exist in this town averaging about thirty members where usually a lot is drawn once a week. The person drawing the lot is excluded

from subsequent drawing, but for that week is given the benefit of receiving from each member of the "turnuhan," a "turno" (8 hats). The drawing continue until each member has obtained the lot. The hats are made at the home of the member drawing the lot, all the other members repair there on a given night at about 8 o'clock and work until each has finished a "turno." The hostess—for the hatmakers are women—provides food and amusement.

The salient points of the "turnuhan" system are the following:

(*a*) Filipino workers, like the peasants of Europe, labor best in groups when the occasion for labor is made a "fiesta."

(*b*) The lottery feature of "turnuhans" is not necessarily important except as it determines the sequence in which the member of a "turnuhan" gains its benefits.

(*c*) This system in a region where labor can often not be bought supplies sufficient labor force to accomplish projects requiring a large number of workers.

(*d*) The system encourages savings, labor, and production.

(*e*) It provides a sufficient amount of products to be commercially worth while.

(*f*) It constitutes a commercial organization than can easily be dealt with by a merchant.

For these reasons, it is believed that modified forms of the "turnuhan" can be generally applied to the production and sale of craft products made in households.

ALBAY

Here the people coöperate with each other only in such matters as building houses (especially after a storm), planting rice, and preparing for weddings and funerals. Those who coöperate with each other are usually relatives, but sometimes very close friends enter in. Nobody receives any pay but merely waits until he needs help from the others. There are no written contracts. They never draw lots to decide anything.

It seems there used to be a system by which a squad was appointed for each part of the work into which it had been divided. The squads worked in turn until the task was finished. Each squad was directed by a "cabo" and usually the oldest man of the community did the appointing. No one received any pay. But this system is almost forgotten now. I am told that they used to coöperate more in agriculture, too. As a rule people hire most of their help in planting rice now. Rice, abacá, and copra are harvested "on shares."

In Oas mutual coöperation among the people seems to be more marked than anywhere else and the following report

was written by Mr. Prudencio Langcauon, a native of that town who is now teaching in the High School who looked up the matter for me there:

1. *Bangahan.*—Suppose a man undertakes to build a house. A number of his friends and relatives would help him without pay. He, in turn, is bound by custom to compensate each one of them in the form of free labor. If any of his friends or relatives ever builds a house, he is supposed to help him without pay. This coöperation is not only seen in building but in repairing houses.

2. *Anreoan.*—The system has perhaps a great economic value. Before the rice-planting season, a number of women (from 5 to 20) get together and form what might be called a company. The head, usually the oldest woman, goes to the rice planters and contracts the work to transplant rice to a certain area of land. Sometimes the mother with all her daughters form a company of rice transplanters. It commonly happens that a small company contracts so large an amount of work that it is impossible for the members to finish it. They then ask another company of women to help them on the condition that the former would help the latter in doing the same amount of transplanting.

3. *Tabang.*—This word literally means "help." This coöperative system is applied to the mutual help of the people in weddings and baptisms. For instance, a man is to be married. One or two days before the marriage ceremonies, most, if not all, of his friends go to his house and help in all sorts of work—decorating the house, cleaning the dishes, making candies, etc. He, in turn, is supposed to help his friends if they ever get married.

4. *Tanod* or *torno* is used in religious ceremonies. Suppose a member of a family dies. For nine consecutive nights friends and relatives of the deceased hold a religious ceremony in the house of the bereaved family. Every night there is a "tanod" or "torno," a friend, a relative, a group of friends or relatives, who supplies the cakes, wines, and cigarettes given to all the people who attend the ceremony. The cakes, wines, and cigarettes amount from ₱5 to ₱10. This bereaved family is bound to "tanod" or "torno"—give help of like nature—when any member of his friend's family dies. The system is used in all religious ceremonies of similar nature.

5. *Ambag and limos*—"Ambag" is the financial aid given by the people to the family who has a son to be married or to be baptized. "Limos" is the same aid given by the people to the family who has a dead member to be buried. The money is given for the sole purpose of meeting all expenses incurred in the weddings, baptisms, or burial ceremony. The family who receives the "ambag" or "limos" is to give the same aid if any member of the family of his friends or relatives is to be married, baptized, or interred. The "ambag" or "limos" ranges from ₱0.25 to ₱10. The average amount is ₱0.50.

ANTIQUE

Pandan District.—Mr. Mariano S. Dioso, supervising teacher, says in his report:

The term "turnuhan" is meant in this municipality "hil-o-jan." In this system the person who wants to have enough sorted abacá fibers, in-

vites several persons (usually women, from 5 to 25) to work for a day or for a night for her at her home. These women sort and join the abacá fibers which will become the property of the woman who invited them. The actual weaving of "sinamay" or "guinaras" is done by the owner of the ordinary loom at her home.

The principal industry in this town among women is weaving sinamay, therefore the "hil-o-jan" system is common throughout the municipality. This system is also applied once a year in the cultivation of rice, such as plowing and transplanting. There are no original documents available concerning this custom. It is said that it is the primitive system practiced by the Philippine aborigines.

Culasi District.—Mr. Clarion C. Gray, supervising teacher, says in his report:

I have made inquiries of the teachers, municipal officials, and older citizens of the town and they know of no such system of coöperative work such as is described as "turnuhan." Some said it might exist in the mountain barrios, but I could find no definite information concerning it.

San Jose District.—Mr. James F. Godward, supervising teacher, says in his report:

I have investigated quite thoroughly and the only thing at all resembling this system is a kind of contract that the people sometimes make for the accomplishment of some common labor, a simple agreement that each will do a certain part of the work. The people of the province do not even understand the word "turnuhan."

Sibalom District.—Mr. Domingo Natividad, supervising teacher, says in his report:

The "turnuhan" system is known as "hil-oa-nay" in this province. This system is commonly practiced by women whose business are the selling of knotted abacá fibers or the manufactoring of native cloths. A woman who has some fibers to be knotted calls in several women, say five of them, to her house to join her in the work until it is finished. The number of days spent by these women in the work is of course recorded. This woman in whose house the work was first performed should also come to the house of one of the five women who happened to need her in the same work. She should also work in all the five. It is of interest to mention here that the women in order to break the monotony take turns in telling stories or else in singing. In other cases the labor is repaid in this manner. Say that Nicolasa owes five "hiril-ohan" to Maria who has many fibers to be knotted but Nicolasa happens to be busy then, or she is not able to do the work. Then Nicolasa calls five women who owed her labor equivalent to five "hiril-ohan" to work with Maria. In this way Nicolasa paid Maria's labor in one day instead of five days by having the five women do the work for her.

The barrio of Bari in the municipality of Sibalom is noted for its pottery. The "turnuhan" system is practiced there and is known as "Daguiao." Whenever a potter receives rush orders for a number of articles, he calls in other potters to help him. He will also be ready to offer his services whenever he is needed by the other potters who worked for him.

Dao District.—Mr. Sabas Tordesillas, supervising teacher, says in his report:

I have investigated the coöperative systems in this district and have found out that the "turnuhan" system is known here as the "hil-o-hanay" system. It is very commonly applied in the productions of hats and cloths; in the preparation of rice land; and in planting and pounding rice.

I have inquired as to the advantages of the "hil-o-hanay" and have been informed by a member of it saying:

"A member of the 'hil-o-hanay' (manoghil-ó) is able by means of this coöperative system to have fabricated a number of hats in a limited time.

"The prepared buri will not stay in good condition for a long time and the fastest weaver can weave only two cheap hats in one day. If a weaver (fearing that if he prepares many buds he can not weave all his materials into hats before they spoil) should prepare only one bud, he would waste his time. If he should prepare many buds, he would spoil before he can weave them into hats. The 'hil-o-hanay' enables each of its members to prepare as many buds as he wants to prepare, and to have them fabricated into hats in a very short time, or before they spoil.

"It is an economy of time in the preparation of our food. If I work alone in my house I shall have to prepare my food every day; by joining the 'hil-o-hanay' I prepare our food but once a week, when my fellow members work for me.

"In the preparation of the rice land, it enables us to do our work more quickly. For instance, early in June when my land is dry and can not be plowed, I work in the land of the other members of the "hil-o-hanay." Then late in June when my land is full of water and when their work has been finished they work with me in my land. In this way we can always plant our land at the right time.

"It makes us happy to work together. If I work alone I feel lazy to work; if I work with my fellow-members I feel happy and I like to work. While working with my fellow-members, I converse and laugh with them and our work becomes but a play."

I have also been informed that at least 25,000 hats are made in this district and exported to Iloilo by the members of the "hil-o-hanay," every year.

Another coöperative system in this district is called the "ilao" and is applied in the preparation of rice land. A man who has no carabao works for another who has carabaos, and in return for his services he is allowed to use the animals of that man, in his own work. This system is very commonly used by the tenant farmers in this district.

REPORTS OF INTERMEDIATE SCHOOLS

Culasi Intermediate School.—Mr. Howard I. Lehman, principal, Culasi Intermediate School, says in his report:

The "turnuhan" system is here known as "daguiao."

Formerly, the "presidente" could compel "daguiao," but as this is now against the law, there are no original documents or copies which I can find to submit.

When a man marries, his friends and neighbors help him build his house. People assist each other in moving houses.

In planting rice, especially in the mountains, people aid each other, all working together to plant first one man's rice and then another's.

When dikes are needed, a meeting is called at which the people voluntarily agree to coöperate in building the needed dikes for the common good.

A man who owns a baroto and net will often obtain help from his neighbors, paying them with a share of the fish caught. But this is not called "daguiao."

The "daguiao" system is most common in the small barrios where the "encargado" or oldest and most respected citizen will lead the people in their coöperative work.

Sibalom Intermediate School.—Mr. Jose Natividad, principal, Sibalom Intermediate School, says in his report:

The "turnuhan" system or "hil-o-hanay" as termed in this province is carried largely by people of the poorer class in the town of Sibalom. It is a great help to the farmers possessing but small tracts of land with one or two work animals.

In the earlier part of the planting season four or five farmers, the kind mentioned above, come to agreement to help one another in turns with their carabaos and necessary outfits. This agreement, however, only includes the plowing and not the planting. The wives and children of the farmers before the farm are ready for planting form coöperative system with other women and children and in this way the farm expenses are cut very low.

Provincial School.—Mr. G. W. Satterthwaite, principal, Antique High School, submits the following reports:

Clark Hallam.—According to my investigation of the "turnuhan," this word is not known in Antique Visayan. There exists here, however, coöperative labor of various kinds.

"Dagyao" means "helping without pay," and is the name applied to the sort of work in which each man is helped in turn by the neighbors without pay, the one assisted being bound to give assistance to the ones who have helped him. In Spanish times, roads, bridges, churches, etc., were built in this way. The most common example now is the building of houses, especially for a newly married couple. This system is also used in constructing dams to protect the barrio from floods, and in a small way, in some other industries. The one who is being assisted in this way is bound to furnish materials and food for the helpers, and the whole affair is made the occasion for a "fiesta."

"Hil-o" means also "help without pay," and is applied generally to this sort of work among women. A bee for the preparing of hemp for the loom is said to be common here. This is also the name given to coöperative plowing, planting, harvesting, and even of pounding rice. Such coöperation is more or less common here, depending on the locality.

"Bulig" is applied to coöperative fishing, but in this, each man takes his share of the fish caught.

Harvey E. Hostetter.—Groups of natives have been seen gathering the rice or bean crop of a neighbor who they expect will help them in return.

Sometimes, also, they turn a hand to help move a house, to doctor a carabao, to irrigate a field or to place a sugar establishment.

At one town visited a man had built a little house in his yard which might be occupied by anyone whose residence would be destroyed by a typhoon. The builder had himself been thus accommodated a year before. It is a custom there.

In a mountain barrio were found several ready-made roofs which were set about like tents on the vacant lots. These were constructed by the more fortunate householders to be occupied by those whose weaker houses might go down in a storm.

Jesus de la Cruz.—The most common work of coöperation or "turnuhan" system practiced in Antique is the joining of abacá fibers. The joined abacá fibers are prepared for the use of loom.

Only women participate in this kind of work. They usually number from ten to fifteen women. They make a verbal contract which bound them to work. The time set for the work is determined by the body itself. The whole number of women works at a specified date for the first number in the list. They follow the order until equal time of work is done for all the members. The order in which they come is determined by drawing straws or by the consent of each member.

The length of time in which they have to work for each member is limited and it is usually nine hours. The skill of the members.

Classification of fibers is taken up in connection with the work, *i. e.*, fibers are graded as first, second, third (pinalasic), fourth (pinalasic sa gamay), and fifth (binagnos). The classification begins with the coarse fibers, the first grade, and follows down to the finest grade, the fifth grade called in Visaya "binagnos." In this case each one provides herself with five small baskets made for the purpose.

The work continues until all the members are benefited equally and the contract is carried out.

Silverio Nietes.—The most common system of "turnuhan" prevailing among the farmers of small means is the "hil-o-anay." It is a sort of organization in which the farmers combine to do a certain kind of work, such as, plowing, planting and husking corn. The "hil-o" conducts the work upon its responsibility dispensing with the work of the entrepreneur. Each member of the "hil-o," in turn helps one another until the work of each is accomplished. This system of coöperation is very advantageous because each works as hard as he could, so that the work could be done by the same number of persons working under an entrepreneur.

Another coöperative system is called "daguiao." There are, however, two kinds. "Daguiao" on farm and "daguiao" on building a house. As applied to farm work "daguiao" is a group of persons or tenants working together under a certain proprietor or landowner who is an entrepreneur. The members of the "daguiao" do not in turn work with each other as in "hil-o-anay," unless the work of an entrepreneur is finished. Then they form a "hil-o" without the entrepreneur who is usually the landowner. "Daguiao" in building a house is a different system of coöperation. The "daguiao" works without payment. The members of the "daguiao" in

this case are the relatives, friends, and neighbors of the bridegroom or bride. These persons when called "daguiao sa balay" combine to build a house for the new couple without any wages of any sort from the bridegroom. The "daguiao" simply renders its services to the bridegroom or bride without asking any form of wage.

David B. Pugh.—Information on this topic seems difficult to obtain. The following information is based mainly on the observation of others.

In this province Filipinos often work together in groups to help each other at rice harvest, building fish dams, raising or moving houses, gathering beans, constructing fences and public buildings, and in time of flood and fire.

It seems to be the custom for the one helped to serve refreshment or food at the time the work is done, and then to assist his neighbors in their time of need.

George W. Satterthwaite.—I have the honor to submit herewith the reports on the "Turnuhan System." The work is not commonly used here in every-day communication, but various forms of coöperative labor are employed. These are defined and summarized below:

"*Bolig.*"—This name is the general term for all kinds of coöperative work. One meaning it may have is "hired man or woman."

"*Daguiao.*"—Coöperation in all sorts of public works.

"*Hil-o-anay.*"—Women tying hemp.

"*Bay-og.*"—Fishermen with barotos hauling in net and dividing the catch.

"*Mañgisda.*"—Fishermen combining and dividing the haul.

"*Manag-á quita.*"—Joint catch of mud-cat in the fields. Water is drained off and catch divided.

"*Mañgayam quita.*"—Hunt for deer, wild hog, and game in which a large circle is formed and game captured together.

Sugar planters often coöperate in furnishing carts and animals to haul harvest to market. Also true of rice crop.

BATANES

The people of Batanes have developed the system of coöperation to an exceedingly high degree. By this I mean the extent of coöperative industry rather than the efficiency of organization and management. All undertakings which require a large amount of labor, such as house building, fishing with nets, "palek" making, roof repairing, and cultivation of fields, are carried out coöperatively. All other industries, such as hat-making, pottery, basketry, and the making of clothes, are individual and only enough of a given article is made to supply the individual's own wants. Their coöperation is of the primitive type—that is, the supplying of just enough to satisfy the home demand—and not for the purpose of accumulating a surplus and selling that surplus to satisfy other wants.

The greater number of these coöperative systems are not based on written contracts but on customs which are as rigid

as a written agreement. Even these written contracts present more form than reality in the actual working of the society. Reading over these contracts, it will be noticed that they are very meager in their assignment of duties. For example, no mention is made of the term of office of president. Hence, even in these societies with written contracts it would be safer to say that the society is based on custom and that the written contract is the attempt of the better educated of the society to put these customs into some sort of a written agreement.

The one thing that is most striking about these organizations is their workability. In fact, the people of Batanes seem naturally to be coöperative individuals. This conclusion is sustained by the almost absolute lack of trouble in the workings of these societies and also by their long life. Asking one of the town presidents regarding the life of these societies I was informed that they were permanent institutions.

Collective buying and selling seems usually to have no part in the program of these societies. However, as will be noticed in the "palek" contract of Ivana dated this year, collective buying and selling has been incorporated. Hence, it may be assumed that this phase of coöperation is beginning to recommend itself to Batanes.

BATANGAS

A careful census of all coöperative systems of labor which exist in this division has been made and only two very simple organizations have been found.

The first system is closely analogous to the barn raisings, husking bees, etc. which exist in many of the rural districts of the United States and is known by the local name "saknuñgan" (often spelled "sacnongan"). A "saknuñgan" is usually organized by a popular or influential man to accomplish some definite project which requires the combined labor of a large number of individuals. The workers voluntarily give their labor and expect no pay other than their entertainment. The entertainment on occasions of this kind is usually very elaborate and often costs as much as the value of the labor received. A "saknuñgan" is usually organized to move a large building, to clear a field, etc. Occasionally an attempt is made to organize a "saknuñgan" to weed or plant rice or to perform other work which could be performed by fewer workers working a longer time. This practice is looked upon with disfavor and a man who attempts it is usually considered to be a grafter.

Occasionally a "saknuñgan" is organized as a charity measure to help some person or family that has suffered losses by flood, fire or some similar disaster. In such cases the entertainment consists of ordinary food or may be omitted entirely.

The other system is analogous to the custom of changing work at threshing and harvesting time which is generally practiced by many of the small farmers in the United States and is known in this division by the names "suyuan" or "buliran." In this organization it is understood that one who received the help of his neighbors will work in each of their fields in turn. The entertainment given at a "suyuan" consists of ordinary food only.

No complex organizations having written constitutions or agreements exist in this division.

There is no system in this district known as "turnuhan." But there are two well-defined systems of coöperation in farm work—"sacnoñgan" and "suyuan."

"Sacnoñgan" is the joint effort of a considerable number of persons (often about 30) to render help to some indiviual or family at the instance of another party, the organizer. The workers never and the organizer frequently receive no return other than the entertainment provided by the beneficiary or in some cases by the organizer of the work. This entertainment consists of food, drink, cigarettes and sometimes music. Instances of "sacnongan" are plowing, planting or weeding the crops and moving, repairing or building a house. Assistance of this kind is rendered to some person or family needing such help on account of poverty or misfortune. Another instance is the harvesting of the crop in which case the organizer receives a share (usually one-fifth of the crop) and he alone furnishes the entertainment. Sometimes the organizer in these different kinds of work is a young man who wishes to help the family of his sweetheart. He never receives any material return.

As distinguished from "sacnoñgan," which is a kind of organized charity, "suyuan" is a true example of coöperation. It is found almost only in the planting, weeding, harvesting and storing of crops, grinding sugar cane, etc., *i. e.*, in those operations which require a number of laborers and which occur regularly on many farms in the same community. The same crop is planted on different farms at different times so that it is possible for the same group of people to go from farm to farm and perform the work next in order, from seed time to harvest. The

owner or tenant of the land invites the people on a certain day to appear at his house for this work and he provides refreshments. Nearly every one of these workers will later on invite this farmer (together with the others) to his own place for the same purpose. The group performing such work will consist of about fifteen persons. This organization is very loose, has no written agreements and exists only during the current season.

In both municipalities of San Jose and Ibaan, there is no organization which has a written agreement or constitution, but in both localities exists a coöperative system of labor which is the result of a long-established custom. The forms which are most common in both localities are what they term "saknuñgan" and "suyuan" or "buliran."

1. The term "saknuñgan" is applied to that coöperative system of labor, in which a certain work such as plowing, weeding, harvesting, building a house, cleaning the coffee orchards and planting sugar cane, is to be accomplished in a day by a number of persons for the benefit of one. When a "saknuñgan" is organized for the purpose of cleaning a rice field of weeds, the term "pahalagap" is used, and the work is always done on Sunday. The form "suyuan" or "buliran" is quite different from that of "saknuñgan," for in the former, the person who has been helped in a certain work, will, under verbal agreement, have to pay each of those who help him an equal amount of labor performed for him by each of them, while in the latter, the beneficiary is under no further obligation to repay those who helped him.

2. In a "saknuñgan," there are usually from 30 to 200 workers or helpers, the number being determined by the amount of work to be performed. But when the beneficiary is an influential man, there are very many helpers, sometimes more than what are required. He often loses in a "saknuñgan," for the amount of food he served costs more than what he receives as profits.

The number of helpers or workers in a "suyuan" or "buliran" is usually small, varying from 3 to 15 only, for those who practice this coöperative system of labor are neighbors, who have the same kind of work to perform at different dates.

3. The person who receives the profit of the labor is not determined by another persons, but he himself decides whether he will be a beneficiary or not.

4. In both "saknuñgan" and "suyuan," the person who receives the profit of the labor furnishes the food for the workers.

In a "saknuñgan" the food served is usually better than the ordinary food of the people, but in a "suyuan," the food offered is just the same ordinary food the people eat.

5. In a "saknuñgan," the entertainment is usually like that of a christening or wedding, but in a "suyuan," the entertainment is hardly recognized.

6. This sort of organization is temporary.

7. There is no written agreement or constitution.

COÖPERATIVE SYSTEM OF LABOR

1. Practically speaking, the coöperative system of labor now in operation in this district, known by the names, "sacnuñgan" and "suyuan," can hardly be called societies, because there is neither written constitution nor by-laws, for either of these systems. The organization is only established by custom.

2 and 3. As to the number of members, "sacnuñgan" has more than "suyuan." The members of "sacnuñgan" is from 8 to 20 or more, of "suyuan" from 4 to 10 or more.

The following description of each system will show the difference between these two:

"Sacnuñgan" is usually used in clearing woods for the plantation of rice, and in harvesting rice.

For instance: John has a piece of woodland, he wants to clear it in a short time, but he does not want to pay for labor, so he goes to his friends and relatives and request them to help him in the work. (As we see the more friends a person has the most workers he gets when he organizes "sacnuñgan.") As these friends and relatives of John work for him under request and not under contract they are not expecting any material compensation for their work, only they know that John would be indebted favors to them and that they can call upon John in time of need.

"Sacnuñgan" is also used in harvesting crop in the same manner as in clearing woodland described above. Very few, however, organize "sacnuñgan" for harvesting crop, because those who do so are considered too ambitious. In "sacnuñgan," only the organizer is the one who gets the benefit of the work and the workers do not receive any material compensation as stated before.

"Suyuan" system is usually used in plowing and weeding. For instance: Pedro's rice field is ready for weeding, he goes to his friends and relatives, whose rice fields are not ready for weeding yet, requests them to help him, under condition that he would help every one of them when the turn of each one comes. In this system each member gets the profits of the work of all. Pedro, however, must be careful enough not to have so many workers, because if he does, he may not find enough time to help every one of them.

4. In "sacnuñgan" as well as in "suyuan," the person who receives the profit is the one who prepares the food and entertainment.

5. In both systems no other features of entertainment is being given except the food and the indispensable cigarettes and buyo and occasionally wine.

6. The organization is purely temporary in both cases.

7. They have neither constitution nor written agreement between the members.

BOHOL

These coöperative organizations are commonly known in Bohol as "hongosay" associations, and are found in every municipality of the province. No definite information regarding their origin and history is available, as no permanent records have been preserved. Mutual assistance seems to be the sole purpose of all such societies. Each society is organized to perform one particular kind of work and is, with few exceptions, a temporary organization. They are well organized, having constitutions and by-laws, which bind the members to remain with their respective societies and perform their duties toward the organizations until the proposed special work has been accomplished. Each member is required to submit a written guarantee to this effect.

The coöperative systems existing in the Province of Bohol may be divided into three general classes—the coöperative labor associations, the coöperative financial or revenue associations, and the coöperative charitable associations. Societies of the first class are formed for the purpose of coöperating in the planting, cultivating, and harvesting of various crops; weaving mats, sinamay, saguran and other kinds of cloths; knotting abacá, piña and raffia fibers; building and repairing houses; and, in a few instances, preparing industrial exhibits. The coöperative system is used extensively in this province in doing the kind of work mentioned above.

One of the municipal presidents, in his reply to my request for information along this line, mentions that "most of our farmers are making use of the 'hongosay' system. It is a substitute for capital, which most of the farmers lack. Their success depends very largely upon these societies, as their members can combine to do work that cannot be done by an individual." Several persons interested in the same kind of work will get together and form a coöperative society, agreeing to aid each other in this work. Usually they cast lots to decide who will receive the first assistance. When a person draws the deciding number, the members of the society set a date on which they will meet at his home and render him the assistance agreed upon. This member is then excluded from the drawing until all the other members have received the same help that has been given

him. Separate organizations are formed for men and women. Those composed of women do such work as weaving, the knotting of fibers and similar work. When such organizations are composed of young ladies they are known as "monosay" or "hanayay" societies. After the work of the society is completed, each member receiving an equal share, the society is disbanded. There is no uniform regulation relative to limiting the number of members in these societies. They usually consist of from five to twenty members, depending upon the amount and nature of the work to be accomplished.

The coöperative revenue societies are organized and conducted in practically the same manner as those of the coöperative labor system. The chief difference is that money, or products of a commercial value, is contributed instead of labor. The people consider this system as a sort of a savings bank. It is not a lottery system, as one without investigating the matter might infer. A member contributes on the installment plan and, in the end, receives in a single sum the total amount of his contributions. Some of these societies are organized for a specific purpose, definitely setting forth the manner in which each member shall use the contributions he receives from the organization. There is one society in Tagbilaran organized for the purpose of securing funds to purchase iron roofing for the houses owned by the members of the organization. Each member contributes ₱10 per month, and, since there are twenty members in the society, the contributions amount to ₱400 in two months. Every second month this sum of ₱400 is given to the member who first submits an application with a certified statement that he is prepared to roof his house. In forty months every member will be provided with an iron roof for his house. This example is a typical illustration of the societies of this class.

The coöperative charitable association differs from the first two in that it is a permanent organization, and contributes labor, money or food and clothing only to those who are actually in need of assistance. The membership in such societies may include the people of a whole barrio. Generally, it is a family affair. The purpose is to assist people who are sick, or who die without having sufficient money for burial purposes. Some of these societies existing today were organized a half century ago, and possibly some have been in existence for even a longer period.

BULACAN

The word "turnuhan" is not very common. None of the teachers were able to define the word until after its significance had first been explained.

In connection with the holding of the various barrio fiestas, those charged with the responsibility for them are chosen by lot in the presence of the old men of the barrio and before the images of the saints. This is called "bunutan" or "sapalaran."

Where persons help each other with their various farm operations in turn, as plowing, rice planting, harvesting, etc. the words "tuluñgan," "suyuan" and "lusuñgan" are used locally.

Mr. Gatmaitan informed me that in any game where the contestants play in turn is sometimes, though very rarely, known as a "turnuhan."

CAGAYAN

There are two coöperative systems of distinct character from "turnuhan" which prevail in some of the communities in this district. These are the "amuyu" or "illu," and "arayat."

"*Amuyu*" is a coöperative system applied to house building, rice planting and such other work as may need a number of workers. It is practiced in the town of Camalaniugan and in several barrios of Aparri. In house building the people, after being notified, gather together and build the house for the owner for nothing. The owner, however, must provide lunch, wine, and sometimes candy for the attendants.

In rice planting or some other work of similar nature the same method is applied.

"*Arayat.*"—This is a coöperative system prevailing among the Ilocanos living in the towns of Aparri, Camalaniugan, and Lal-lo. When an event such as wedding and baptism takes place the neighbors and friends duly notified of the event donate some rice, fish, wine, money, or other things worth donating toward the celebration.

The former is not in its full practice now as it used to be. In the past this prevailed among all the Cagayanes in the northern part of Cagayan Province and it was strictly observed.

It seems to me that the term "turnuhan" is derived from the Spanish word, "turno" which means turn, succession or order. "Turnuhan" system is perhaps the system of order in which farmers work their fields when they have agreed upon to help each other.

As far as I know, farmers in this part have the incentive to coöperate among themselves in plowing and harrowing their farms. The old men (farmers) have the custom to assemble in a place to talk about plowing the fields. Here they decide which field is to be plowed first, second, etc. alternately. In their meeting they do not have officers. Anybody is allowed to speak. The will of the majority however is to be carried on. The young farmers just follow the will of the old one.

The owner of the field to be plowed will not pay any to the workers, but he must provide food, wine, tobacco, buyo and sometimes candies for them. These are usually taken to the place where they are working. They eat and drink under the firmament and the sun shines over their heads. They keep on doing this until all the farms are tilled.

In some places a farmer who is destitute of animal just helps those who have some by arranging the pilapils or by being a cook for them, and will have his field plowed and harrowed just the same as the others. He is helped all the way through the season provided he keeps on helping the other who have animals.

This is also done during planting time if the rain is not late. Otherwise everybody gets busy to plant his own field for fear that the rice plant will not grow high enough before heavy rain comes which causes the fields be covered with muddy water.

This process is not done at the end of the season. Each and everybody harvests his own crop. He invites outsiders to help him.

Farmers in the barrios of Claveria and Sanchez-Mira have societies the object of which is to promote and improve the rice field irrigation system. All the rice fields in Claveria are irrigated. The farmers here can plant rice during the driest part of the year if they care to as they can draw water from the river easily by means of their irrigation. This municipality raises one crop during the year.

The farmers in the neighboring barrios of the above municipalities organized into societies or clubs elect officers from among themselves to plan and to direct the work to be undertaken. The officers of these clubs are usually men of experience not necessarily learned men. I am told that the chief of the club which has the largest irrigation system watering the largest tract of land in Claveria is an old man who can hardly read and does not write and yet he could plan and direct the work.

Farmers who do not join the club in making the irrigation have to give to the club 10 per cent of what they can harvest

from their fields if they use and draw water from the system. The collection of the club is either sold or deposited for future expenses.

It takes from three to five years for fifty men working together to finish an irrigation system which can irrigate 1,000 hectares or more of land. It is understood that the workers work from five to six months during each year.

These poor farmers as I see, work hard day and night yet they do not progress for the simple reason that they are too extravagant in their vices and too ignorant as to the places where they have good market for their products. They usually sell their products within the locality among influential people or Chinese in the central part of the town who are generally cheap buyers. There is no mutual protection between the farmers and the merchants.

It is expected that this lamentable situation of farmers will be remedied by the agricultural society now being organized in each municipality under the direction of the Bureau of Agriculture.

Origin of the term, "turnuhan."—The term is of Tagalog origin. The last syllable "han" is very common in the tagalog dialect, and when added to a word it changes the application of that word. "Turno" is a modification of the Spanish term "turno," a word very commonly used in accomplishing or going through a thing, either for pleasure or for an end—industrial or otherwise.

Equivalent terms in dialect.—The term "turnuhan" and its application is very well known by the other peoples here due to the fact that the tagalog residents still use the term. Among the Cagayanes (natives) "abuyog" is the equivalent term, and among the Cagayanes from Cabagan and Tuguegarao the term "agubue" is used; and among the Ilocanos "ammoyo." The term has evidently suffered changes the extent of which depended upon the dialect of the people, their understanding of the term, and more so upon its application.

The term "turnuhan" must have originated from one place and it may be positively said that it is known all over the Islands in connection with the industrial coöperation.

How applied.—In some of the tagalog provinces, such as Laguna, Bulacan, and Rizal indoor industry is one of the principal means of earning a livelihood, the term is applied to the production of handicraft articles—hats, mats, embroidered articles, etc.

In this district, however, where indoor industry is not in vogue for earning a livelihood the term "turnuhan" or its equivalent is applied to what I may call, outdoor industry; for instance, the planting of tobacco, corn, rice, and husking rice. It is used in the building of houses, "camarins," putting up fences for the common good; and few years ago, when the making of cigars for sale, locally, was not restricted by the Bureau of Internal Revenue it was also applied.

Planting of tobacco, corn, rice.—A man who is ready to plant his tobacco announces the day set for his planting, to others in the barrio. When that day comes the (members of) people, who, by custom, has become members of the coöperative system, "abuyog" or "agubue" are to gather at home of the man who is ready to plant. There they wait for the completion of certain traditional performances before going out to plant. They coöperate until the work is completely done.

Building houses.—To make the thing interesting as well as informing, let the "agubue" or "abuyog" system as applied in the barrio of Dammang of the municipality of Echague be cited:

In that barrio there is a written agreement signed by those declared as members relative to the building of houses or "camarins." The agreement, abridged, goes like this:

We the residents of the barrio of Dammang of the municipality of Echague, present in this gathering, having realized the advantages of coöperating in the accomplishment of an end, do hereby draft the following as agreement:

"That a member of this agreement who wishes to build a house or 'camarín' must notify and solicit the help of the others;

"That the member who solicits such help must have everything ready for the construction of the house or 'camarín';

"That he must feed the members of this 'abuyog' or 'agubue' system during the days that the construction is under way;

"That the construction does not take place during the time that every member of this agreement is engaged in the plowing of the fields;

"That no two members of this agreement each build a house at the same time for obvious reasons;

"That any member whose house or 'camarín' was built by the members of this agreement, that refuses to render his services to others, is subject to have his house, built under the provisions of this agreement, destroyed by the members. Sickness will be considered as an excuse."

And to guarantee our compliance to the above provisions each and all of us sign or cross our names on the present in the presence of the "teniente del barrio" and "juez de cementera."

This agreement or "convenio" as the people call it is in the possession of the teniente.

The supervising teacher failed to get the document because the man went to Bayombong.

Such agreement or "convenio" is known among the Cagayanes as "abuyog" or "agubue," and among Ilocanos "amoyo."

Husking rice.—The procedure in securing the coöperation for the husking of so many "cargas" (one carga—32 gantas) of rice is similar to that of planting of tobacco, with this difference: The men and women pound the rice to the accompaniment of music furnished by the "cinco-sinco," a guitar in miniature of five strings. This gives life, fun, frolic to the work.

From foregoing paragraphs it may be taken as an established fact that there is such coöperation to promote material welfare in this part of the country; that the term "turnuhan" as applied to industrial coöperation in the Tagal provinces has its equivalent here, "abuyog" or "agubue" terms that are almost identical in meaning and application; that the application of the system is to outdoor industry here due to difference in industries.

CAMARINES

It is an old custom in Lagonoy, and even at the present time for friends of the groom, when the "bans" are published in the church, to collect in a body and put up the frame work of a house. The work may continue until the house is finished if the groom supplies food and drink. This system would be called an "onglonan."

The following distinction is made in the use of this word—it should be applied only to work done voluntarily by the people and not on call of an official. When done at the call of an official it would be called a "rabos."

ILOCOS NORTE

The "onion" or "guimong" is an industrial coöperative organization which is commonly found among the masses where the standard of living is of the same level, and who have common interest in the same community. In every barrio outside the poblacion the "onion" is always organized. Though at present this organization is dying out in the heart of the towns where the standard of living is not uniform, still there are traces left to show the existence of it; still you can see the whole neighborhood in a group pounding rice or sewing cloth to be used by a future bridegroom, etc.

The members of which this league is composed are near relatives or those whose houses are grouped together in a community.

The main purpose of the "onion" is to retain a close relationship of people of the same family or neighborhood through working mutually for every one's interest. And having few means, every member can plow his field or build his simple house without spending a considerable sum of money for the work.

The members of the "onion" system do the following work:

1. Building or repairing a house.
2. Plow, plant, and harvest rice.
3. Cutting wood in the forest.
4. Weaving and sewing cloth.
5. Hunting or fishing.
6. Pounding rice.

Documents are seldom done in writing when these leagues are organized since most of the members can neither read nor write. However, the duties of every member and the regulations prescribed are so easy for all to keep in mind.

A family is represented in the "onion" by a man or a woman. The man is to do the hard work such as building a house, etc., and the woman for harvesting rice, or any light work prescribed in the agreement.

Sometimes when there is no available man to do a hard work such as in repairing a house, a woman may be allowed but she will be given a light job, say cooking or fetching water for the men who are repairing the house.

The ablest or oldest person in the community is the leader (pangoloen) of the "onion" and any one of the members who needs some help, repairing his house, for instance, he appeals personally to the "pañgolo" who will call a meeting of all the members. At the meeting they fix the day of the work.

It must be borne in mind that the member who needs the work has to furnish all materials and food needed. He tries to entertain well all his workers by killing for food a big fat pig or probably a carabao (a big fiesta for the workers) and gives them enough buyo and tobacco, and "basi" to drink.

The length of time in which the "onion" works in a member's house is fixed according to regulations. But generally two or three day's work are long enough. In the case of cutting wood in the forest one week is a sufficient time.

This system of work comes by turns to every member of the "onion" during the year whenever each of them needs some help.

In case some one is absent in the work on account of groundless reasons, he will be fined with money according to the rate

of wages in vogue in the locality. The money thus collected will be turned over to the member who should have employed him.

The reader will suppose that the members of the "onion" are kept busy during the year round by helping each other with their labor free. No, the house is repaired but once a year and it will not take all the members to do the work in a day. Plowing a rice field, planting it or harvesting the rice in it will not take more than a day.

In cutting wood in the forest for building a house, it takes the whole "onion" to do this in a week or two. Therefore, this kind of work being a long one, it is done but once a year, and it takes place when they have few things to do, in the month of November before the rice becomes ripe.

Though there is no law to compel the members to comply with all the regulations prescribed by the "onion," yet every one does his duty faithfully. They keep good order.

This is a good institution as is evidenced in the following instances: On May last year when a furious typhoon visited this province nearly all houses were blown down.

The destroyed houses belonging to the "onion" were rebuilt quickly as soon as the storm was over because the owners could help each other by turn in spite of their lack of funds. By means of this coöperative system of labor, rice is harvested at once before it gets overripe; the ground is plowed in time before the water becomes scarce. Everything is done in a short convenient time without considerable expenses on the poor people. As a result of this mutual work all the members as a whole are bound together with the tie of helpfulness and protection of one another.

ILOCOS SUR

Coöperation among the people of Ilocos Sur is found mostly in the agricultural occupations though it also occurs in a few instances among merchants and villagers. It varies from the help given at a wedding or funeral and which is practically a donation from which there may not be a return to the work done upon irrigation and other projects where the amount of work for each individual is definitely prescribed in a written constitution and each benefits in proportion to the amount done by him.

For convenience therefore in dealing with coöperative associations, the subject will be divided into three divisions: first, cases where help or money are given with the hope and ex-

pectation that if certain things happen, the donee will return the gift with or without increase; second, cases where help is given and while there is no definite agreement for a return, yet the custom of the town, barrio, or locality is so strong that the donor is practically sure of being repaid in money or labor; third, cases where money or help is contributed with either a written or verbal agreement to govern its return or the profits derived from its use.

While cases in the first division do not belong strictly to coöperative associations, yet, they are so closely connected with the idea of mutual help that they are included in this report.

First division.—Throughout the province wherever a man has a house to build it is customary for him to go around among his neighbors a day or two before the work is to be begun and ask their help. During this work called "tagnawa" the beneficiary furnishes food in large quantities and circulates *basi* "to make them free talkers rather than hard workers." When the work is finished the evening is spent in more feasting and drinking and often in dancing. No other remuneration is given to the workers, but whenever any of them wish to build a house the persons for whom they have worked are expected to help them. Similar group work occurs at the time of a wedding or funeral when it is necessary to build a veranda or addition to the house to accommodate the guests. Friends and relatives at these times are expected to bring gifts of chickens, rice, and other edibles. This kind of help and aid occurs quite generally throughout Ilocos Sur and Abra and depends to quite an extent, of course, upon the desire of the people to get together and have a feast as well as upon the desire to aid their neighbor.

Second division.—Under the second division but closely connected with the above comes what is called in the native dialect "arayat" and "tupac." At the time of the marriage of a couple the relatives and acquaintances of a family help them to bear the expenses of the festival. This help is usually in the form of money and custom requires that it be always repaid but only at the time of marriage in the family of the donor or lender. The part that goes to the parents for expenses is called "arayat," that which goes to the couple is called "tupac." In both cases the names of the givers and the amounts are placed in a list, one copy of which is for the parents and one for the young married people. The giving of "arayat" begins immediately after the young people arrive from the church and stops at noon.

During this time the person appointed takes in the money and enters the name of the givers and amount in the list. He has at his side vino and cakes and as the person hands in his money the writer gives him a drink of vino and some of the cakes. The money thus collected is turned over to the parents in whose house the feast is given. "Tupac" is collected later at the time the young people leave the house and is turned over to them to help them get their new home started. The writer or collector sits in the center of the room and spins a peso on the table to show he is ready to begin. As the money donated for the bride is kept separate from that given to the bridegroom rivalry is aroused between the friends of each as to which side will give the most. After the giving is over the money is put in one pile and given to the bridegroom who in turn gives it to the bride. "Arayat" given to the parents must be repaid by the parents, while the "tupac" given to the couple is repaid by them.

"Ammoyo" or "gamal" is a kind of group labor which depends upon custom. This labor usually occurs in plowing and planting rice fields and is quite general throughout the province. Several owners of small pieces of land work together, first on one piece, then another, until all are plowed or planted. The owner of the piece upon which the men are working usually furnishes the food. No definite agreement is made among them as to the amount of work and the necessity of repaying it, but custom is so strong that seldom or never does a man whose land has been worked by the group fail to help each of the others. If he is sick or for some other reason he cannot go, he sends his wife or son. In case he should fail to return the help given him he would be disgraced among his people.

"Reddec" is the term used when a man in a barrio kills a pig or a carabao, or vaca and distributes the meat among his neighbors. They are compelled by custom to repay him either in meat when they kill an animal or else in labor according to the amount of meat given them.

Third division.—We now come to the last division in which the coöperation of the members of a group are regulated either by oral or written agreements. Among the forms of group labor of this class the most common in the Province of Ilocos Sur are the irrigation associations. The organization and operation of these associations varies in different localities. As usual thing, however, the owners of land to be irrigated make a contract or oral agreement. In this agreement provision is made

for the yearly election of officers—"cabeza" or "presidente," "encargado" or treasurer and various other leaders. The amount of work to be done by the members is usually determined by the amount of land owned or in some cases a record of the annual produce of the land of each member is kept and the owner is required to pay or work in proportion to such produce. Members are expected to work when called upon by the officers and leaders. In case a member is called upon to work and he fails to appear at the appointed time and does not hire a laborer to go in his place or contribute food or *basi* for those working he is fined from ₱0.20 to ₱0.50 per day depending upon the time of the year and the amount of work to be done. In some cases the laborers while working furnish their own food, in others they furnish only the rice, meat, etc. being purchased with the money derived from fines or else from assessment (cadaoyan) of all the members. In one or two towns a percentage of all the grain raised on the irrigated land is collected and turned in to the treasurer to be used the next year to feed the men while working. Money is also often brought into the treasury by the sale of water to the other barrios.

After the irrigation work is completed or at the end of the year a party is usually held at the house of the "encargado" or treasurer, to which all the members and persons who are interested in the association are invited. The business of the association is then transacted and an accounting of the income and expenses of the association is made and new officers are elected.

In the municipality of Santa Maria are found onion growers associations. Ten to twenty people agree to grow onions together. Each member furnishes seed onions to be planted and when the harvest comes takes out a share equal to the amount of seed furnished by him. The rest is divided equally among the members of the association. An arrangement similar to this is made among some buri mat makers. Several people get together and make mats in common. They appoint one or two of their number to take the mats to other towns for the purpose of selling them. The money derived from their sale is divided equally among the makers. Stone workers also have the "ragup" system as it is called. They form a working company select a headman and a clerk. The later acts as agent and keeps a record of all expenses and sales, also he keeps all manufactured articles. From time to time an accounting is made and the profits are divided.

In the southern part of Vigan there is an association known as "The Society of the Poor." A copy of its constitution together with a translation is attached. This society has its regularly elected officers and its members are divided into groups of ten. Over each group is a cabeza or headman. The purpose of this society is to help its members in times of necessity and especially to take charge of the bodies of its dead members and see that they are properly buried and the expenses paid. Each member pays into the treasury ten centavos as an initiation fee and thereafter one centavo monthly or more as he wishes. When a member dies the "cabeza" of that group reports the fact to the president. The officers of the association then allot a certain amount of money—from ₱5 to ₱10 for a child and from ₱10 to ₱20 for a grown person—to defray the cost of burial and to furnish food, vino, etc. for those attending the funeral. In the case of baptisms and weddings the help of the members of the society takes the form of gifts of chickens, rice, pigs, etc. The society now has a membership of about one hundred and has been in existence over three years.

During the last two years there has been organized in Cabugao a progressive society with a written constitution. This society is known as "La Esperanza" and is in the nature of a stock company. Each member on joining pays in ₱10 and the profit from the different activities of the society is divided among its members. The society has tienda or store and does a general retail business in *basi*, bagoong, corn, rice, beans, tobacco, buyo, and spices. The sale of these commodities is carried on under separate departments as shown in the abbreviated draft of its constitution which is translated and attached.

LAGUNA

"Turnuhans" were originally beneficial and coöperative associations having their origin in those pioneer localities where labor was not to be obtained for money or where the money was lacking to pay for the labor.

Several neighbors would agree to work together in clearing a field, leveling a rice paddy or building a house. The drawing would indicate only the order in which they would work. Ten men would agree that they should build houses worth ₱500. They could not get this amount of money together working as individuals so they would agree to each furnish ₱50 and then draw to find out whose house should be constructed first. After all had made their lucky drawing and all enjoyed their new houses the contract was considered closed. Those who made a

lucky drawing would, before drawing a benefit, furnish a bond that they would continue to comply with their contract and help the other members until all had their turn. This was merely paying for the house on the installment plan; the more fortunate enjoying the house while paying installments, while the less fortunate paid their installments before enjoying the house.

Women sometimes find it lonesome working all day making hats and they agree to get together where they can work and gossip at the same time. They take turn about in appropriating the proceeds of the days work. In some cases each member binds herself to furnish a certain number of hats each week, thus keeping up the speed of production.

Young men bind themselves to serve at the wedding of their companions. They carry the wood and water; serve at the table and do several other things to make the bride and groom comfortable. Failure to comply with the contract is penalized by a fine. They not only agree to serve one another in life but also to serve and attend at the funeral in case of death.

These "turnuhans" have in the past been exceedingly beneficial as they were merely simple mutual aid societies and not enough money was involved to attract the cupidity of crooks and confidence men.

Recently there have been organized several money "turnuhans" and the contracts are sometimes intentionally made so as to permit of doubtful transactions. In some cases they provide for benefits on marriage or death. A mutual life insurance company transacting business without proper medical advice needs government attention.

LA UNION

The "turnuhan" for the production of handicraft articles does not exist in La Union. Similar institutions, however, are found under the local name "gamal" or "pinta." The "gamal" is not formally organized and has no permanence.

The "gamal" is used in building houses, making fishing nets, making caingas and sometimes in plowing for rice. For example, when a house is built, the builder will invite his neighbors and friends to assist. The assistants receive no pay, but are plentifully supplied with food and drink while working. The one assisted is under no obligations to repay his helpers, but he generally does, by helping them in their "gamal."

The "gamal" is not unlike the barn raisings, the log rollings, husking bees, etc. of early days in the United States.

LEYTE

After a careful study of the different phases of coöperative work in this province, I find that the ones most common are "ticlos," "doce-doce," and "tag polo." These forms are used in harvesting crops and are explained as follows:

"Ticlos" is a form of coöperative work wherein the people come together to help gather the crop. Sometimes this same man is expected to return this help to all the participants.

"Doce-doce" is another form whereby the one who helps gets as his share of the work done, two parts out of twelve.

"Tag polo" is another form used in harvesting crops. The owner gives six gantas for every ten brazas square of ground harvested.

OCCIDENTAL NEGROS

In this Province of Occidental Negros, a true coöperative "turnuhan" system is not found, but after a careful investigation of the matter as required by the inclosed letter of the Director of Education dated July 31, 1914, which has been endorsed by the division office to me, during my travel to some towns in this province, I have found out that one of the coöperative systems, which exists in Occidental Negros, is the extracting of hemp from the abacá plants and this is done by the following ways:

Whenever the abacá plants are matured and ready to be used for their fibers, the owner of the abacá plantation calls for some workers in his locality to begin extracting the fibers from the plants.

These workers are given neither money nor food, but receive a certain per cent of the fibers extracted. They are privileged to sell their shares of the fibers wherever they choose.

The other coöperative system which is also found in this province, is the weaving of "patadiong" or "tapis." This is done by the following methods:

Any woman who has money to buy materials for the above-named article, gathers some women to fabricate a certain number of "patadiong" for her.

These weavers are not given money for what they have fabricated for her, but they receive one-third of the number of the articles manufactured as their wages or shares. Sometimes the owner of the materials buys the share of the workers at 20 per cent lower than the ordinary market price, and sometimes they are also privileged to sell their shares wherever they want.

PALAWAN

The coöperative or "iriloan" system, as it is known locally, has been in existence here since time immemorial, though the origin of which cannot be safely explained. It is presumed that it is an old trait of the Malays brought over on their settling this island. Nevertheless, it works here very successfully for certain reasons, besides interesting and amusing.

During the season of works on the rice fields in Cuyo, several women and big children gather at the field of a given member to work there for one whole day; on the next day for the second given member, and so on until each one is worked for by the same number of persons as he worked of days, and so on. Save during the planting season in which a big midday meal is always prepared for the workers by the person they work for, people who thus work, feed at their homes. Men rarely join in this work.

This system prevails only among people who are naturally devoid of means with which to hire hands. In fact, some of the members of this "iriloan" do not even have land or place on which they will bring their "pabales" or turn to work on. In this case they sell it to any well-to-do people who may have need of labor at the usual rate of wages. The work of these workers is always very satisfactory, and desirable.

When these people are at work they really work hard and eagerly as if they are employed in their own task. There is no discontentment of any kind. Everybody is light-hearted. In fact, their high-spiritednes is demonstrated by their sweet singing, merry talks, and hearty laughters. The right of them is very fascinating.

Similar method is followed by the local weavers of "patadiongs" and "camisas," except that the workers all consist of women or girls, work indoor, and are fed by the person at whose house they gather to work. Men, likewise, follow this system when engaged in building their bamboo houses, fish corrals, etc. In no instances has ever been known that a written contract has been made out when organizing this system. It is simply recognized to be a hearty coöperation among members of the same neighborhood.

SAMAR

The only coöperation known to exist is a sort of reciprocative interests in agriculture. A purely verbal arrangement is sometimes made among farmers who desire to have their crops planted and harvested in common. The system is known as

"ticlus" and greatly resembles our common "husking bee." The member who desires to have his land or crops attended furnishes the food and amusement for the other members, who in turn do likewise when their crops require the same attention. The arrangement is mutually agreed to, and no documentary procedure is observed.

SORSOGON

There are a few coöperative systems among the land-owning farmers. Some are for the purpose of irrigating their rice land. They dig and keep in repair the irrigation canals and have an agreement as to the distribution of the water. Others are for the purpose of planting and harvesting. These unions consist of from ten to twenty relatives and friends. The plan is as follows: when one farmer is ready to harvest or plant his crop, the other members help him without pay. Some had the plan of all members hiring out together to a neighboring hacendero when not working on the farm of one of the members. The money thus received would be used in some common improvement to their farms. These unions have usually lasted for a few years and then broken up. No union has been found that had written rules and regulations.

SURIGAO

The system as found here is a custom found to prevail in certain localities.

"Tagbo" is voluntary labor given gratis to public improvements such as building schoolhouses, churches, cleaning plazas, streets or cemeteries or in building or improving roads. This custom is general throughout this section and people readily respond when called on for their assistance.

"Jungos" is similar to "tagbo" in that the labor is gratis, but differs in that it is obligatory and applies to field work—such as planting, cultivating, and harvesting crops. This custom prevails only in certain localities. It has been in operation for years in the barrios of Timamana, Placer; Malimono, Surigao; Tagnipa, Cagayan; and in several barrios of Cantilan and Gigaquit. It was by means of this system that Tagnipa became at one time the greatest corn-exporting barrio in the Philippines. The "tagbo" is as old in Surigao Province as the Mamanwas. They invariably work together when they decide on a new location for a barrio till all the houses are finished.

The Filipinos' love of company may be used as an incentive to profitable labor, still, it is believed that the selfish side of

his character together with his natural desire to possess what he himself has produced should be looked upon as being the real mediums through which application to manual labor may be secured.

TAYABAS

General statement.—The general principle of the "turnuhan" system is the same all over this district, but the various towns vary a little in the organization of it. Sometimes there is a very loose organization; sometimes, they have officers, such as a president and a vice-president, and a secretary. In the first case mentioned, it only runs for a few days; in others, it may run for weeks, *i. e.*, the various members may go round several times, or after taking all the lots, one of the members who has more land may hire the others who have less to work for him for money. Sometimes, when one man's turn comes, he may agree with the other members to give his turn to another man and miss his own. Thus, one man gets two days in succession. Sometimes, an outsider hires the whole "turnuhan" and the money is divided among the members. Any of the members may hire all the others too, except on certain days, which are, generally, Tuesday and Friday.

Sometimes, the "turnuhan" is made up of single men only. In case of the marriage of one of them, they all work for him a certain time or do certain stipulated things to him. In case one can not give his share, he has to pay a fine. These donations are: a hen, a ganta of rice, twelve eggs, and a bundle of firewood. On the day of the marriage, all help about the house at whatever there is to do. This system lasts only till they all are married.

Work done.—Among the things done, are: making strings for nets, fencing the rice land or coconut land, cleaning the "caingin," cleaning the land for coconuts, building houses and cutting shrubs. On the appointed day, they all meet and draw lots. The one who draws No. 1, gets the work of all of them and so on until the last member has received the same benefit. In some barrios, the same group works together each year; in others, it only lasts a short time and is reorganized again this year or next with other members. In case of planting upland rice, the hard work is quickly over and the actual planting is then done by the mother and children while the father works out his time with the other members.

Conditions of work.—The one for whom they all are working furnishes the food and drink. The latter is generally a bottle of Ayala Gin. Each member agrees to abide by certain rules: No one is to rest for more than a certain time; no one is to chew betel nut; no one is to take time to sharpen his tools during the work time; and no one is to be absent without a valid excuse. In the case of sickness, by agreement of all, the absent member may be excused, or he may be fined a certain sum or be asked to furnish a bottle of gin for the treat of all.

Days and times of works.—Some "turnuhans" fix Tuesdays and Fridays as their days of work and work only on those days. Others work each and every day till the work is done. The time of work is from 7 to 12 and from 2 to 5.

Variations of the "turnuhan."—In some barrios, as in those of Gumac, this systèm is called "suyuan" and is without pay. They only harvest rice and clean it and in this form the members may be as few as four. In some barrios, it is not found at all.

The following extracts from various replies will give an idea of what the "turnuhan" is in Tayabas:

Let us take the case found in the barrio of Esperanza (municipality of Lopez). There are 10 members in this "turnuhan." Member No. 1, is determined by lot, as is the order of the remaining 9 members. No. 1 has the first "turnuhan."

This "turnuhan" comes twice a week, on Tuesday and Friday.

This "turnuhan" consists in working on the farm. If for example No. 1 has a "turnuhan" day he can assign the remaining nine members to work in his rice field and "caingin," or he can have them work in cleaning under the coconut trees, or any kind of work in his farm which he likes. (*From report of Victor Oblefias, Lopez.*)

In Marinduque, there is something similar to the "turnuhan" in the construction of houses, in planting "caingin," and in making sinogot. In these three industries the custom is simply to invite friends or neighbors and furnish food, these friends or neighbors returning the invitations as occasion offers. (*From report of C. I. Halsy, Marinduque.*)

At Lucban the "turnuhan" is said to be a "money turnuhan" and is a form of lottery.

At Sampaloc a labor "turnuhan" is reported. This is similar to that in the barrio of Esperanza, at Lopez.

At Mauban there is money "turnuhan" on a rather large scale, the amount being at times as much as ₱1,000.

It is reported from Mauban that the "turnuhan" is applied in the hat industry. Each member of the "turnuhan" making a determined number of hats for the lucky member. Here too it is applied in farm labor in securing a larger organization of men for clearing, plowing, etc.

THE "TURNUHAN" SYSTEM IN LILIO, LAGUNA

In my recent inspection of the agricultural credit coöperative associations in the Province of Laguna, especially in the municipality of Lilio where our association has been stagnant since organizing, the people seem to have lost all interest in its progress. After inquiring into the cause of such indifference, I learned that the farmers and others in this locality had been the victims in past years of various sorts of illegal transactions by various mutual associations which had existed there. Upon investigating I learned that for a number of years there were operated in the municipality of Lilio three societies which are locally called "turnuhan."

A "turnuhan" is a sort of mutual association composed of a limited number of members each of whom pays ₱0.50 a week which is the price of a numbered ticket, these tickets run from one to eight hundred or to one thousand, as the case may be. Every week a sort of lottery or raffle is held to determine which numbered ticket is the winner of the prize consisting of the total amount paid in by all subscribers, say ₱400 or ₱500. But the winning member does not get the whole sum in cash, he leaves half of that amount in the society from which, after certain deductions have been made, the balance is kept as a deposit in his name to be invested by the directors and is used as security for the winning member's future weekly subscriptions.

There were three "turnuhan" companies operating in the municipality of Lilio in 1911; one was denominated "Turnuhan Polistico" and two were called "Turnuhan Banahaw". There is a full record of the "Turnuhan Polistico" in Civil Case No. 2447, Court of First Instance, Santa Cruz, Laguna, the Law Office of Messrs. Sumulong and Lavides is suing in behalf of 800 victims for an accounting. I will, therefore, confine my report to my investigation of the other two "turnuhans." I will call the one composed of 800 persons as "Turnuhan Banahaw-Four" and the other composed of 1,000 persons as "Turnuhan Banahaw-Five," because they are locally called "Turnuhan Banahaw-Apatan" and "Turnuhan Banahaw-Limahan." These two "turnuhans" were operated under the one management of Buenaventura Dimaguila, Maximo Parfan, Jose Esmilla, and Jose Montesines, though the funds were kept entirely separate. The undersigned was unable to examine all details of these two "turnuhans" because the books which were used during their existence are carefully guarded by the persons who are involved in the business. However, I

had access to the cash book by the "Turnhuan Banahaw-Four from December 17, 1911, to November 23, 1913, from which I obtained important data. During this period I found that the sum of ₱7,451.27 (see Exhibit No. 1) was loaned on real estate with an annual interest of 25 to 30 per cent and all the unexpended balance was given in lump sums on different dates to the president of the association. These sums amount to ₱8,627.50 (see Exhibit No. 2), none of this money has ever been accounted for. On August 5, 1913, three items appear on the credit side of the book of "Turnuhan Banahaw-Four" which state: "Money advanced to three "aparceros," named D. Huelva, ₱150; E. Quijano, ₱100; and V. Alcantara, ₱70, totalling ₱320, which show that at that time the "turnuhan" owned certain parcels of agricultural land, but nothing could be learned as to who obtained the product of same, but it may be presumed that the directors got the crops."

As I have said, the operations of the two "turnuhans" were kept apart. "Turnuhan Banahaw-Four" was under the management of Jose Montesines, while "Turnuhan Banahaw-Five" was under Jose Esmilla. But the profits which were derived from the operations of these two "turnuhans" were combined into a single fund and sometime before the Provincial Governor stopped these two "turnuhans" in 1917 a large transaction in real estate was made. A large coconut plantation in Candelaria, Tayabas, and 20 heads of carabaos were purchased with the united profits of both "Turnuhan Four and Five" for ₱8,000 from Hermenegildo Nadres. In the document the amount was inflated to ₱20,000 and the deed of sale was made out in the name of Buenaventura Dimaguila, Maximo Parfan, Jose Montesines, and Jose Esmilla without mentioning the "turnuhan" at all. This property was sold in 1919 to Anselmo Nadres for ₱13,000 thus gaining a profit of ₱5,000. The 20 heads of carabaos were sold to Gil Rada of Atimonan, Tayabas. The amount of the sale is not known as it has not been recorded in the books. The amount of ₱13,000 for the plantation was not received in full. According to Maximo Parfan the amount received was only ₱12,000, of which ₱9,000 was deposited in the Philippine National Bank and ₱3,000 was distributed, Maximo Parfan received ₱1,000; Jose Montesines, ₱700; and Jose Esmilla, ₱1,300. Buenaventura Dimaguila, the president of the "turnuhan," being dead at that time, did not get any share, The ₱9,000 deposited in the bank was later withdrawn and distributed in the following manner: Maximo Parfan, ₱500; Jose Esmilla, ₱500; Jose Mon-

tesines, ₱500; Pablo Parfan, the son of Maximo Parfan, ₱500; and ₱7,000 was loaned to Brigida Comprado, mother-in-law of Jose Montesines. This division is matter of court record in the case brought in the Court of First Instance, Laguna, by Jose Esmilla against the other three managers of the "turnuhan." On June 12,1920, Jose Esmilla, one of the directors of both "turnuhans," presented a complaint in the Court of First Instance of Laguna requesting ₱1,950 out of the ₱13,000 realized from the sale of the plantation in addition to the ₱1,300 he had already received. His contention was that all the money invested belonged to the four persons who composed a private partnership, therefore the suit was brought to divide all the property into four equal parts and he wanted his share. He completely ignored the existence of the 800 members in one "turnuhan" and 1,000 members in the other who had deposited half of their winnings each week with the officers. He tried to show that the Candelaria Coconut Plantation was the joint purchase of the four directors with their own money. Maximo Parfan, Jose Montesines, and the widow of Buenaventura Dimaguila, to escape the danger of repaying any money, stated in court that all the funds invested were "turnuhan" funds and entered a counterclaim that the plaintiff, Jose Esmilla, must return the ₱1,300 to the fund held in trust for the members.

The court decided that the sum of ₱8,000 which was invested in the sale of the property of Hermenegildo Nadres really belonged to the Turnuhan Banahaw; that the Turnuhan Banahaw was really a sort of a lottery or raffle, a game of chance which was prohibited by law. That the board of directors of said "turnuhan" simply made investments of the money entrusted to them and wrongfully divided among themselves all the trust funds. It was therefore ordered that the court record be indorsed to the provincial fiscal of Laguna for an investigation and action as to whether there was any ground for a criminal prosecution. The decision was signed by Judge Cayo Alzona on April 28, 1925. Until now nothing has been done.

During the trial it was also alleged by Jose Montesines, one of the defendants, that all the books which they have used during the operation of the "Turnuhan Four" and "Turnuhan Five" were still in the hands of the bookkeepers, Dr. Victoriano Camello, a dentist by profession, residing at Lilio, Laguna, and Jose Compendio. Maximo Parfan, however, told me that the books of the "Turnuhan-Five" are still in the hands of Jose Esmilla, but the latter has always concealed those books because he did not

dare to produce them as he himself declared in the Court of Laguna that there were no such "turnuhans."

To give an idea of how the accounts of these associations have been kept, the following notes, taken from the cash book of "Turnuhan Banahaw-Four" fom 1911 to 1913, will show that there are certain items which have been intentionally entered to conceal the illegality of the transaction. The following illustrations will give an idea of the method:

RECEIPTS

(Debit side of the Cash Book)

No. 1. GRATIFICACIÓN. This represents the percentage paid to the "turnuhan" by the winning member. A sort of an income of the society.

No. 2. FONDOS. A certain percentage deducted from the amount deposited by the winning member. The winning member who is awarded a prize of ₱400 must deposit the sum of ₱200, and from this ₱200 a certain sum is deducted and kept under a separate account, called "Fondos."

No. 3. DEPÓSITOS. This represents the half of ₱400 which is kept by the society in the name of the winning member.

No. 4. ACCIONISTAS. This represents the amount of ₱0.50 paid by every subscriber every week.

No. 5. DEUDORES. This item which they sometimes call "deudores de acciones" is the same item as No. 4 but is paid later.

No. 6. COMPRA-VENTA. Whenever any person redeems his property or pays back his loan to the association, it is carried under this account which is nothing but a debit side of the investment.

No. 7. DEUDORES POR CANON. This represents the interest on all the loans given by the society or rental from the property owned by the society. This usually ranges from 25 to 30 per cent.

No. 8. PARTIDA EN SUSPENSO. This represents the amounts received from time to time by the president of the association who seems to be the depositary of the surplus fund.

DISBURSEMENTS

(Credit side of the Cash Book)

No. 1. TURNO. This represents the amount paid to the winner. As we have said, the winner is credited with the sum of ₱400 every time the lottery is made.

No. 2. NÚMEROS DEPOSITADOS. This represents the amount advanced by the association for the unsold tickets from the general fund.

No. 3. PARTIDA EN SUSPENSO. Under this account all the amounts given to the president of the association as unexpended funds of the association is kept. According to Exhibit No. 2, from December 17, 1911, to November 23, 1913, the president of the association received ₱8,627.50.

No. 4. DIRECTIVA. This represents the salaries paid to the board of directors. According to the statement of Mr. Maximo Parfan each of the four directors and one representative received ₱10 a month and during the operation from August 1911 to March 1916, each of these four directors and one representative should have received ₱790 each totalling ₱3,950. This is only for "Turnuhan-Five."

The following persons appear in the cash book to have received from "Turnuhan Banahaw-Five" the amounts set opposite their names:

Pedro Guevara, Representative	₱790.00
Buenaventura Dimaguila, President	790.00
Maximo Parfan, Cashier	790.00
José Esmilla, Secretary	790.00
José Montesines, Member	790.00
	3,950.00

(The statement of Maximo Parfan is that the amounts which appear as his salaries have never been paid to him.)

No. 5. FUNDADORES. This represents the fixed dividends paid to the "fundadores." In the case of "Turnuhan-Five" there were 13 founders and each of these from July 1911 to March 1916, received ₱3 a month or ₱237 each, totalling ₱3,081.

Granting that these dividends have been paid regularly from July 1911 to March 1916, the following persons should have received the amount set opposite their names:

B. Dimaguila	₱237.00
M. Parfan	237.00
J. Esmilla	237.00
N. Esmilla	237.00
J. Montesines	237.00
F. Montesines	237.00
C. Fama	237.00
H. Brosas	237.00
H. Novenario	237.00
F. Miogro	237.00
M. Montejo	237.00
G. Conosa	237.00
L. Noble	237.00
	3,081.00

In the cash book of "Turnuhan-Five," a few days before the suspension of the operation of the association, the following doubtful entries which were not supported by any voucher appear:

April 9, 1917, efectivos entregados	₱527.50
April 10, 1917, efectivos entregados	1,287.00

These two amounts, according to Maximo Parfan, were distributed among the members who had not been lucky in drawing a winning number. The names of the persons who received these amounts were not mentioned in the cash book. Mr. Maximo

Parfan further stated to me that there is still a balance of about ₱1,500 in the hand of Jose Montesines of "Turnuhan-Five" funds, and they are only waiting for the decision of the court in order to dispose of that amount.

I went to the house of Mr. Jose Montesines and inquired about the present status of the society, and he said that the operations, having been considered illegal by the court, the managers considered it closed. But upon further inquiry, he finally admitted that he still possesses certain documents of loans granted to the members which have never been collected. The documents showing the names of the borrowers and the amount owned by each of them are listed on Exhibit No. 3. When I asked him about the money, which, according to Maximo Parfan, he still has, he flatly denied having any. I asked him about the account book, and he said that many of the members borrowed it and never returned it.

It is impossible to determine the money loss and moral harm inflicted on the people by these "turnuhans." Between 1911 and 1917 there were dozens of them scattered throughout Laguna Province. In every case the most respected, prominent people managed them. Large houses, and fields are pointed out everywhere as having been bought with "turnuhan" funds and kept by various "turnuhan" officials. No accounting has ever been demanded. The people took their loss as a consequence of bad luck. The Government officials seem to have been overawed by the social and political standing and backing of the respectable men who managed these "turnuhan" lotteries for six or seven years until closed by the provincial governor in 1917.

A suit was filed in the Court of First Instance of Laguna in July, 1917, against the "Polistico Turnuhan Co." of Lilio to secure an accounting for ₱97,000. It will be heard soon.

The Court of First Instance of Laguna, in its decision in the case brought by one director of "Turnuhan Banahaw" described above, against the other three directors for his one-fourth of the "turnuhan" funds, ordered the records of the case to be sent to the provincial fiscal for investigation and action. Nothing has been done yet.

Confidence in every enterprise is destroyed. The fact that the leading people in many towns can openly steal thousands of pesos and never even be questioned about it lowers the ideas of honesty and integrity and places a premium on crime.

I submit this detailed report on two "turnuhans" in Lilio, Laguna, to help the authorities to take action.

Appendix A

CONSTITUTION OF THE SOCIETY OF THE POOR
VIGAN, ILOCOS SUR

PREAMBLE

We, the undersigned, live in the western part of Vigan, Province of Ilocos Sur, P. I., and in order to show our union and willingness to help one another, we hereby adopt the following constitution:

ARTICLE I

SECTION 1. The name of this society shall be "The Society of the Poor."

SEC. 2. The members of this society shall sign this constitution and shall promise by oath his faithfulness and honesty to uphold this constitution.

SEC. 3. Each member shall pay an initiation fee of ten centavos before signing this constitution.

ARTICLE II

SECTION 1. The purpose of this society shall be to help and bury the dead members of the society or the dead in the family of a member, and also those who are not members provided the society shall deem it necessary.

SEC. 2. It may also give entertainment and amusements whenever the members desire them.

ARTICLE III

SECTION 1. Each member shall give an offering of from one centavo up every month.

SEC. 2. Each member shall give offering to a person designated by the society.

ARTICLE IV

SECTION 1. This society shall have a president, a vice-president, a secretary, and a treasurer.

SEC. 2. The president must be of age and must know how to read and write Ilocano correctly.

SEC. 3. Duties of the president:

a. To preside at all meetings.

b. To make suggestions regarding the betterment of the society, provided it is approved by the majority.

c. It will be through him that the expenses of the society shall be paid.

d. To audit the Book of Offerings and of the Treasury once every three months.

e. He shall not have the power to vote on any motion except when given by the society special power to do so, or in case of tie.

SEC. 4. The vice-president shall have the qualifications of a president.

a. He shall take the president's office in case of absence in the meeting, or in case of sickness or death of the president.

SEC. 5. The secretary shall also have the qualifications of the above-mentioned officials. He must be able to speak and write Spanish or English correctly.

SEC. 6. Duties of the secretary:

a. He shall make all records of all the doings of the society in the meeting.

b. He shall announce all meetings.

c. He shall be the one who will explain to the society all laws which are not clear to the members.

SEC. 7. The treasurer shall have all the qualifications of the above-mentioned officials, and he shall have no vices which are detrimental to his work and he shall have land enough to apply the money charged up to him in case of loss.

SEC. 8. The treasurer shall have two persons to act as security and to show that he has the necessary property; these two persons shall be heads of families and shall be of age.

SEC. 9. The treasurer shall be responsible for the following:

a. He shall receive all offerings, regular and special.

b. He shall show the money in every regular meeting.

c. He shall not give out money without the consent of the society and the approval of the secretary.

d. He shall have to pay all money lost while in his care, and shall pay a fine of the same amount of money he lost in case he cannot give a good reason for the loss.

ARTICLE V

SECTION 1. The said officers of the society shall be elected by ballot.

SEC. 2. No candidate shall be elected to more than one office.

SEC. 3. There shall only be three candidates for every office.

SEC. 4. Each officer elected shall have to take an oath before taking his office.

SEC. 5. These officers shall be changed every year.

SEC. 6. In case an officer dies, commits crime or goes away for a long time before the expiration of his term of office, he shall be changed by a special election of the society.

ARTICLE VI

SECTION 1. There shall be a committee of four, three of whom shall constitute the judges of the election and the fourth shall act as secretary.

SEC. 2. The members of this committee shall have the qualifications of the other officers, that they shall not be able to become candidates for any other office, that they shall have supreme voice in the election and shall be elected from all parties.

SEC. 3. Duties of the committee:

a. To preside over the election.

b. To fix the time of election.

c. To make laws and regulations regarding the election.

d. To publish the result of the election.

ARTICLE VII

SECTION 1. This society shall have both special and regular meetings.

SEC. 2. The regular meeting shall be held on the first Sunday of the month at 6 p. m.

SEC. 3. The special meetings shall be held at any time needed.

SEC. 4. The president or any ten members may call a special meeting.

SEC. 5. The quorum, both in special and regular meetings, shall consist of the majority of the members.

SEC. 6. All business can be transacted by the majority of the quorum.

ARTICLE VIII

SECTION 1. The society shall enact laws forcing the members of the society to comply with the laws passed by the society.

SEC. 2. Any member who fails to obey the laws of the society shall be punished by a two-third vote of the members present; but he shall not be able to exempt himself from the meetings.

SEC. 3. The society shall not spend the money unless it be for "death."

ARTICLE IX

This constitution can be amended at any regular meeting by a two-third vote of the members present, but in case any amendment is to be made it shall be made known to every member of the society one month before it can be acted upon.

Vigan, August 27, 1911.

AMENDMENTS

ARTICLE I

This society shall have a representative who will give full information in case the Government demands information, or in case a private person wants such information.

ARTICLE II

This society shall have a subtreasurer, a subsecretary, who will act when the treasurer and the secretary are absent.

ARTICLE III

SECTION 1. By majority of the members voting a person who is not sick and has no sickness in his family will be admitted into the society.

a. There will be a committee of three members appointed by the president to investigate into the conditions of the members admitted.

b. If found to be false in any way to the society each member of this committee doing the act will be fined from five to ten pesos or will be expelled from the society.

SEC. 2. Each member is required to pay an entrance fee of ten centavos beside the regular monthly fee of twenty centavos.

ARTICLE IV

SECTION 1. A member who violates the rules and regulations of this society shall be expelled.

SEC. 2. A member who cannot pay three consecutive monthly fees shall be expelled from the society. Such persons shall never be admitted into the society again.

ARTICLE VI

Rich person shall not be admitted into this society, but free giver is never rejected. The donor's name together with the donation will be entered on the record book.

Appendix B

TYPICAL NAMES APPLIED TO TURNUHAN AS ARE USED IN DIFFERENT REGIONS OF THE ISLANDS

Albay.—Bangahan, Anreoan, Tabang, Ambag, and Limos.

Antique.—Dagyao, Hil-o-hanay, Manoghil-ó, Ilao, Hil-ó, Bulig, Bay-og, Mangisda, Manag-á kita, and Mañgayam kita.

Batanes.—Palek.

Batangas.—Saknungan, Suyuan, Buliran, and Pahalagap.

Bohol.—Hongosay, Bonosay, and Hanayay.

Bulacan,—Bunutan, Sapalaran, Tulugan, and Lusungan.

Cagayan.—Ammuyu, Illu, Arayat, Abuyog, and Agubue.

Camarines.—Onglonan and Rabos.

Ilocos Norte.—Guimong.

Ilocos Sur.—Tagnawa, Tupac, Gamal, Reddec, and Cadaoyan.

Leyte.—Ticlos, Doce-doce, and Tagpolo.

Palawan.—Iriloan, Tagbo, and Hungos.

Laguna and Tayabas.—Turnuhan.

OPINIONS OF THE DIRECTOR OF AGRICULTURE ON RURAL CREDIT QUESTIONS [1]

1. HOW TO ENJOY THE BENEFIT OF AN EXTENSION OF TIME IN WHICH TO REPAY THE LOAN, AS PROVIDED IN SECTION 15 OF ACT NO. 2508. (MUNICIPAL TREASURER, LAMBUNAO, ILOILO.)

"Whenever a man desires to enjoy the benefit of an extension of time in which to repay his loan, as provided in Section 15 of Act No. 2508, it is always necessary for him to obtain the permission of the board of directors, which is the only body empowered by law to approve or disapprove any request for such extension. In the event, however, that the borrower desires to make a partial payment to the treasurer on account of the capital or the interest thereon, the treasurer should accept such payment and issue the necessary receipt therefor for the amount thus paid and make the necessary notation in the ledger where the individual account of said borrower is kept separate from others, according to the new rural credit accounting rules and regulations. But this does not mean, however, to imply that the loan has been extended; for the reason that, as has already been stated before, such an extension has never been formally granted by the board of directors. Even if the borrower has made any partial payment on account of his loan for the interest thereon, so long as there has not been any express authority from the board of directors authorizing said extension, said board of directors is free to exercise any legal action to enforce the total payment of a loan.

"It should be borne in mind, moreover, that an extension of time for the payment of any loan due and payable on a specific date, whenever said loan is guaranteed by personal bonds or by the signatures of two solvent bondsmen, should not be made without the consent and approval of the former bondsmen or without the borrower's submitting new bond to the satisfaction of the board.

"All extensions not evidenced by a new promissory note and bond are considered to be null and void."

(*Letter, November 17, 1925*)

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2. REPAYING A DEPOSIT WHOSE RIGHTFUL OWNER IS DEAD. (MUNICIPAL TREASURER, JANIUAY, ILOILO.)

"Answering your inquiry, as to the manner of repaying a deposit the rightful owner of which is dead, and the reimbursement of which is now claimed by his widow, this office is of the opinion

that the widow has the right to claim all the amounts due her late husband. We however deem it necessary to require the widow to submit an affidavit to be sworn to before the Municipal President, proving her status and stating all the facts regarding the death of her huband, and that the affidavit should be attached to the voucher as a supporting paper thereof.

"The reason for making the affidavit before the Municipal President is to prevent the claimant from spending a heavy sum of money simply to establish her right to claim the deposit of her husband and to protect the association from any illegal demand of any third-party claimant.

"There is no doubt that Jose Lopez is dead and that Felicidad Catequista is the widow. At least, these facts are known to the members of the board of directors, so there will be no fear that a third person may come afterwards to present a claim for the same deposit.

"You are therefore hereby authorized either to pay Mrs. Felicidad Catequista or issue in her name a new deposit certificate in lieu of the one previously issued in the name of her husband."

(*Letter, September 23, 1926*)

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3. A DELINQUENT BORROWER WAS FOUND TO BE INSOLVENT AND OBTAINED HIS LOAN WITHOUT ANY SECURITY. (DR. JOSE DE JESUS, CALUMPIT, BULACAN.)

"* * * If one of the borrowers from the Calumpit Rural Credit Association is now insolvent and obtained his loan without any security, the collection of same together with the interest due must be made proportionally from the members of the board of directors who voted for the approval of the loan in question at the time it was applied for by the borrower. Section 6 of Act No. 2508 reads as follows:

SEC. 6. The credit operations of these associations must be witnessed by a promissory note or other document, signed by the applicant for the loan and accompanied by a personal, or pignorative, security or mortgage upon real state.

"Failure of the members of the board to strictly comply with the above-quoted provisions of law excuses no one of them who voted for the loan from being held responsible for the payment of same to the association."

(*Letter, January 3, 1927*)

4. GRANTING A LARGE AMOUNT TO A NEEDY FARMER. (MANUEL ESTIPONA, GUBAT, SORSOGON.)

"Agricultural Credit Coöperative Associations, created under Act No. 2508, as amended, have been organized to help the small farmers who, because of their lack of securities, are not in a position to approach the banks to borrow money in small amounts to help them in their agricultural undertakings. One of the objects in organizing these associations was also that small farmers might have a source from which they could borrow money at a reasonable rate of interest, so that they would not be compelled to go to the heartless usurers who, in the guise of 'ready helpers,' get from their victims all they have! So that these associations may be most helpful to their members in particular and to the community in general, it has been the common practice for them to loan their funds in small amounts, thus enabling them to give aid to the poorest members. You can therefore readily see the impracticability and inadvisability, if not the impossibility, of persons owning large 'haciendas' borrowing money from them in large amounts, for if this were to be allowed, the small funds of these associations would be monopolized by 'hacenderos' and in such a case the intent of the Legislature in enacting the law governing these associations would be defeated.

"There is an Agricultural Credit Coöperative Association in Gubat from which you may inquire whether their by-laws permit the granting of large amounts, such as you say you need, and whether said association has sufficient funds for that purpose."

(*Letter, July 22, 1927*)

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5. PAYMENT ON ACCOUNT IS NOT AN IMPLIED EXTENSION OF THE LOAN. (MR. ANTONIO HABANA, CAPIZ, CAPIZ.)

"* * * No debt can be considered extended unless the written consent of the board of directors shall have first been obtained. Neither is the treasurer of an Agricultural Credit Coöperative Association empowered to authorize the extension of any loan.

"The mere paying of one-fifth of the obligation is nothing but a payment on account. The original contract can not be affected by any further act unless the conformity of the board of directors has been sought and obtained."

(*Letter, August 8, 1927*)

6. WHEN DOES THE BUREAU OF AGRICULTURE INTERVENE IN THE ADMINISTRATION OF A RURAL CREDIT ASSOCIATION. (MR. FULGENCIO IDOROT, DAO, ANTIQUE.)

"The management of the rural credit association falls under the exclusive control of a board of directors. Possibly it is not unknown to you that this Bureau only intervenes in the affairs of an association when the law, the by-laws or the rules for general procedure have been violated. The running of an association, as long as it is done in conformity with the law, needs no interference from this office. The members of the board of directors are supposed to work unselfishly for the best interest of your community in general and of the members in particular. In case the members of the board of directors do not do their duty as they are expected to, the members have the power to oust them and select good ones. The shareholders can exercise their right by voting in the general meeting and by insisting on a clean administration."

(Letter, May 26, 1927)

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7. NO FIXED FORM FOR WITHDRAWAL OF SHARES. (MRS. PRESENTACION A. VILLANUEVA, ALIMODIAN, ILOILO.)

"There is no fixed form for withdrawal. You must write a letter to the board of directors asking that you may withdraw your shares and state the reason why and if possible you had better personally give it to the president of the board and explain your reasons to him. You could ask for the sum invested to be paid now and the dividend earned by the shares could be paid to you later when the auditor has examined the accounts and passed them."

(Letter, May 27, 1927)

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8. THE SHERIFF WHO SOLD THE PROPERTY OF A BORROWER DISREGARDING THE PROVISIONS OF SUBSECTION (*f*), SECTION 42 OF ACT NO. 2508, MAY BE SUED IN THE COURT.

"It appears from the attached documents that on June 1, 1927, the deputy provincial sheriff of Pangasinan sold at public auction some parcels of land belonging to Agustin Carranto, in spite of the third-party claims presented by said president and

the provincial fiscal of Pangasinan in behalf of the Agricultural Credit Coöperative Association of Bayambang, Pangasinan, and the Insular Government, respectively. The price of the same was ₱1,000, distributed as follows:

Lot No. 1	₱20.00
Lot No. 2	50.00
Lot No. 5	100.00
Lot No. 6	100.00
Lot No. 10	20.00
Lot No. 11	200.00
Lot No. 12	510.00
Total	₱1,000.00

"All the above-mentioned lots were sold to the plaintiff Tomasa Aguilar, who is said to have offered a bond of ₱3,000.

"Before the complaint was filed by Tomasa Aguilar in the Court of First Instance against Faustino Latina et al., Agustin Carranto, a codefendant in that case, had not directly encumbered his property to the plaintiff, while long before that date said Agustin Carranto received a loan from the Agricultural Credit Coöperative Association of Bayambang, Pangasinan, directly pledging his property, and also constituting himself a guarantor for the loan obtained by the Agricultural Credit Coöperative Association from the Insular Government.

"According to subsection (*f*), section 42, of Act No. 2508, the credits of an Agricultural Credit Coöperative Association against its members for sums borrowed by them shall have preference as regards collection over any other claim except in case of a duly registered hypothecary credit on real or personal property, and in the case of taxes, within two years after such taxes become due.

"Hence it is clear that the Agricultural Credit Coöperative Association of Bayambang, Pangasinan, being a creditor has a preferred right to the property of Agustin Carranto over Tomasa Aguilar and it is therefore suggested, as a means to recover from said Agustin Carranto the amount he actually owes to the association, that a civil complaint be filed in the Court of First Instance against him and Tomasa Aguilar, invoking in the complaint the provision of subsection (*f*), section 42, of Act No. 2508, above mentioned."

(*Indorsement, July 14, 1927*)

9. THE MUNICIPAL TREASURER CANNOT RECEIVE ANY ADDITIONAL COMPENSATION. (MUNICIPAL TREASURER, VALLADOLID, OCCIDENTAL NEGROS.)

"* * * The Insular Auditor has ruled that under no circumstances can remuneration in any form be given to municipal treasurers from the funds of the rural credit associations. We have no choice but to obey this ruling, so the above-mentioned voucher is herewith returned to you, disapproved."

(*Letter, April 29, 1927*)

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10. THE BUREAU OF AGRICULTURE HAS NO POWER TO COMPEL THE MEMBERS OF THE BOARD OF DIRECTORS TO ATTEND THE BOARD'S MEETING. (MR. MATIAS PALOMAR, TAPAS, CAPIZ.)

"We regret to say this office has no authority to compel the members of the board of directors to attend a meeting and to impose upon them any penalty for not so doing. A rural credit association is a corporate body, and authority rests on the members convened in a general meeting. If they see that something wrong has been going on in their association, two-thirds of their number can at any time call a general meeting to resort to whatever remedy they please to take in order to correct whatever is wrong.

"We are mere advisers and supervisors. We give advice to all rural credit associations when asked to do so. We supervise their workings and try to correct their errors, but we have no police power to punish the culprits. Being a member of that association you have the power in your hand to exercise and you can do more good for your own association than any outsider can."

(*Letter, March 24, 1927*)

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11. NO AVERAGE FARMER CAN GET A LOAN OF ₱3,000 FROM ANY RURAL CREDIT ASSOCIATION. (MR. L. M. ANTIFONA, LIBACAO, CAPIZ.)

"The Rural Credit Association from which you got a loan of ₱200 cannot supply large loans to all its members, it is only intended to help out in pressing needs with small loans.

"No bank would loan money without sending an inspector and having a clear title, therefore this source is impossible. Money can be easily loaned here on city property, so those having money would not loan it on distant land when they can loan it under their observation on city property without any trouble.

"What the country needs is a system of provincial banks that would loan sums of ₱500 to ₱5,000 to help farmers, and the Rural Credit Associations ought to be better managed to attract more capital to meet temporary needs of small borrowers."

(*Letter, March 30, 1927*)

12. LAZARO TRILLO RECEIVED FROM GORGONIO SAN JUAN ₱130 PAYABLE IN AGRICULTURAL PRODUCE AT THE ANTICIPATED RATE OF ₱2—A CUNNING ATTEMPT TO EVADE USURY LAW. (MR. HILARIO Z. ELUMBA, BUTUAN, AGUSAN.)

"It is evident that the document signed by Lazaro Trillo, whereby he acknowledges having received from Gorgonio San Juan the sum of ₱130 and promises to repay that amount in coconuts every three months beginning June 1, 1927, to December 1, 1928, at the anticipated rate of ₱2 per hundred, is a cunning attempt to evade the Usury Law by making it appear as an innocent purchase of coconuts at a stipulated price. It is illegal for it is a manifest violation of section 8 of Act No. 2655, which provides as follows:

SEC. 8. All loans upon which payment is to be made in agricultural products or seed or in any other kind of commodities shall also be null and void uniess they provide that such products or seed or other commodities shall be appraised at the time when the obligation falls due at the current local market price; and any person or corporation having paid otherwise shall be entitled, in case action is brought within two years after such payment or delivery, to recover all the products or seed delivered as interest, or the value thereof, together with the costs and attorney's fees in such sum as may be allowed by the court. Nothing contained in this section shall be construed to prevent the lender from taking interest for the money lent, provided such interest be not in excess of the rates herein fixed.

"Lazaro Trillo, in signing this contract, pledged himself to deliver to Gorgonio San Juan 6,500 nuts piled near the river, at the rate of ₱2 per hundred, and until the ₱130, received in advance from San Juan, was paid, not to sell or otherwise dispose of his produce.

"There is no doubt that the question involved in this case is that of the proper interpretation of the contract and whether the validity of same can be sustained. My personal opinion is that this contract being illegal *per se* will not be upheld by the Court. Justice Malcolm in his brilliant decision said in R. G. No. 13708, U. S. *vs*. Francisco Constantino Tan Quingco Cua:

It is an elemental rule of contracts that these should conform to the existing laws at the time of perfecting said contracts.

"Neither can it be alleged that this is a transaction where the creditor may be subject to any loss due to the fluctuation of market price, because he is sure to get a certain number of nuts regardless of any circumstances. The rôle played by the creditor in this particular transaction is that of a profiteer who advances money to farmers at usurious rates with the advantage that he will either get his money and interest or agricultural

products worth still more as having been acquired at a ridiculously low price.

"It seems that this contract should be considered null and void because of its illegal exactions of assessing the produce with which it is to be paid *below the market price at time of payment.*

"The law (Act No. 2655) considers usurious sums that have actually been paid in money, or produce in excess of the legal rate; the act of usury must be consummated to constitute a crime for either criminal or civil procedure.

"Therefore, the contract being usurious *ab initio* for reasons above stated, it is up to you to block this contract, which requires payment in coconuts to begin on July 1, 1927. Possibly, the best plan would be to notify the lender that the contract does not conform to Section 8 of Act No. 2655 and therefore will not be carried out, but that the ₱130 loan will be paid at the time stipulated (June 1, 1927, to December 1, 1928) with interest at 12 per cent per annum as the security is real estate.

"It would be better for the debtor to be sued than to sue, to avoid unnecessary expenses. The creditor will probably not go farther than to demand his money immediately. There is no way of escaping the payment sometime of the ₱130 with interest, but this payment need not be made with coconuts far below their real market value.

"I recommend you to read the decision of Justice Malcolm in the case above cited, which has brought to light the following syllabus:

> The form of a contract is not conclusive; parole evidence is admissible to show that a document although legal in form is in fact a stratagem to cover usury. If in the interpretation of a transaction the corrupt intention to violate the Usury Law is apparent, the Court will not permit any means however ingenious to becloud the crime of usury.

"It appears to me that this is a loan and the excessive interest is concealed in the low price of the nuts. The fact that the ₱130 is guaranteed by the land makes it clear that the creditor is not a copra merchant buying produce in advance at current market price, but a money lender who in 18 months expects to get a usurious profit on his investment."

(*Letter, March 29, 1927*)

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13. SUCCESSION OF MEMBERSHIP. (PET. I. VALLEJO, BAYOMBONG, NUEVA VIZCAYA.)

"The father of A, a deceased shareholder, should present an application to the board of directors requesting that the money for the shares belonging to the deceased be either paid to him or

the shares transferred in his name. The applicant must attach to his application all the necessary documentary evidence, proving that his son is really dead; that the applicant is the nearest relative of the deceased and that there has been no letter of administration of the estate of the deceased issued by the Court.

"The board of directors, in the light of the proofs thus presented, will approve the transfer of the shares in question, as requested, and a resolution will be passed to that effect.

"A's father should surrender the cretificate of stock for cancellation.

"The treasurer, acting on the resolution of the board of directors, should attach the old certificate to its corresponding stub with a red-ink notation, " Cancelled and substituted by Certificate No. (Giving the number of the new one)," made on the face thereof, and issue a new certificate in favor of the father of the deceased.

"If A's father is not already a member, he should pay the usual entrance fee upon receiving the new certificate issued in his name.

"Let it be understood that if A's father is not yet a member of the association, the board of directors may disapprove the transfer, and in this case the death of his son will be considered as withdrawal from membership and the rules contained in Section 30 of Act No. 2508 shall apply."

(*Letter, August 3, 1927*)

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14. AN AUXILIARY JUSTICE OF THE PEACE WHO TRIES A CASE FILED BY AN ASSOCIATION, BECAUSE OF INCOMPETENCE OF THE REGULAR JUSTICE OF THE PEACE, IS ENTITLED TO FULL PAY. (MR. ANTONIO FROILAN, CALBIGA, SAMAR.)

"The case in point is that you, being the president of the Rural Credit Coöperative Association of Calbiga, Samar, and at the same time justice of the peace of the same municipality, are unable to try the cases which will be instituted by the association against its debtors.

"SEC. 211 of the Administrative Code provides the following:

> The auxiliary justice of the peace shall perform the duties of said office during any vacancy therein or in case the regular justice of the peace is absent from the municipality, or of his disability or disqualification or in case of his death or resignation * * *.

"In this case it is evident that you, being the regular justice of the peace, are unable to decide the cases which the rural

credit coöperative association might institute against its debtors, and hence the intervention of the auxiliary justice of the peace is indispensable.

"The question now is whether in such case the auxiliary justice of the peace shall act only as your deputy or shall really perform all the duties of a justice of the peace. As to our opinion: the auxiliary justice of the peace shall in this case perform all the duties of a justice of the peace and shall not act simply as a deputy. So true is this that the auxiliary justice of the peace, in acting upon said causes, has the right to receive the salary accruing to the justice of the peace.

"That provision which says that an auxiliary justice of the peace shall receive compensation in an amount equivalent to the fees accruing in such cause, refers only to the actions of the auxiliary justice of the peace when the regular justice of the peace certifies to a certain former case which he himself cannot decide for the reason that he is engaged in another case.

"Section 223 of the Administrative Code provides the following:

> In cases where the justice of the peace, without ceasing to act as justice, shall certify any case to the auxiliary justice of the peace for trial, the latter shall receive compensation in an amount equivalent to the fees accruing in such cause * * *.

"From the foregoing provision of law it is to be inferred that it is applicable only when the auxiliary justice of the peace shall be obliged to try a case assigned to him without the regular justice of the peace ceasing as justice. When the causes instituted by the rural credit coöperative association of that municipality against its creditors were taken into court for trial, you, being the president of the same, should not act as such justice, but the auxiliary justice of the peace should act as the regular justice of the peace, and consequently should receive the salary accruing to the office. You, on the other hand, should not receive any salary during the time you were not acting as such justice.

"We request you, notwithstanding, to send a note of consultation about the same matter to the provincial fiscal, giving him thereupon a copy of this opinion, in order that a fixed rule may be established on this point."

(*Letter, June 30, 1927*)

15. A NONMEMBER WHO BUYS A SHARE FROM A MEMBER MUST APPLY FOR MEMBERSHIP. (DR. LUIS SANTIAGO, SAN MATEO, RIZAL.)

"Section 25 of Act No. 2508 provides the following:

The shares shall be registered and shall not be deemed transferred, mortgaged, or pledged without the consent of the board of directors.

"From the above provision of law it is clearly to be inferred that in order that the transfer of any shares may be considered legal and absolute, it is necessary that such transfer be registered in the books of the association and with the consent of the board of directors. The mere indorsing on the back of the certificate of stock by the former owner in favor of the bearer or the new holder is not regarded as a complete transfer.

"The usual procedure to be followed in these cases is as follows:

"First of all, the original owner should accomplish the indorsement on the back of the certificate. Then it is submitted to the board of directors for action. If the transferee is otherwise eligible for membership, and the board finds no serious objection to the transfer made and the personal qualifications of the transferee, a resolution to that effect should be passed by the board, and the president and the secretary of the association should sign the indorsement made. From that time, the transferee acquires full right as a member, though it is necessary that the old certificate be presented to the treasurer for cancellation, in order that a new one may be issued in favor of the new owner. The transferee should then be required to pay the usual entrance fee and the transfer fees provided for in the by-laws of the association. It is not necessary that the transferee should file a formal application for membership, because the mere act of requesting the approval of the transfer made in his or her name is tantamout to applying for membership."

(*Letter, March 22, 1927*)

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16. THE PURCHASER OF A SHARE FROM A MEMBER IS NOT A DULY QUALIFIED MEMBER IF HE FAILS TO COMPLY WITH THE NECESSARY FORMALITIES. (DR. LUIS SANTIAGO, SAN MATEO, RIZAL.)

"If the transfer of any shares has been made without the formalities mentioned above having been complied the status of the transferee is that of a nonmember. He will not be re-

cognized as a member of the association, because the essential requirements in that transfer such as the registration in the books of the association have not been complied with. But if, on the other hand, the transfer has been authorized by the board of directors and the president and the secretary have signed on the back of the certificate of shares, even if the old certificate has not been cancelled and exchanged for a new one by the treasurer, the holder of the certificate so transferred will be recognized as a stockholder, and will therefore be entitled to receive the dividends when these are declared."

(Letter, March 22, 1927)

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17. THE TRANSFEREE CAN APPLY FOR A LOAN AFTER HE IS ELECTED AS A MEMBER. (DR. LUIS SANTIAGO, SAN MATEO, RIZAL)

"Before the transferee can obtain a loan, he must pay the necessary entrance fee and the transfer fee provided for in the by-laws of the association. These fees may be deducted from the amount of loan to be given him or paid in advance by the borrower. But even if the transferee has failed to pay the entrance fee and the transfer fees, that defect will not in any way be considered as a reason for the disapproval of his application for a loan. If he is entitled to a loan, he may be given a loan, but before or upon receiving the money from the treasurer he must pay all his dues."

(Letter, March 22, 1927)

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18. PROCEDURE OF EXECUTION OF THE PROPERTY OF A BORROWER AGAINST WHOM JUDGMENT HAS BEEN PRONOUNCED BY THE COURT. (FELIX B. VALDEZ, SANTA IGNACIA, TARLAC.)

"The usual procedure is that the sheriff goes ahead with the execution of the judgment of the court and then submits his account after the judgement has been served and executed to the board of directors for its final approval. The association cannot advance any amount to anybody because no amount can be taken from the treasury of the association without the corresponding voucher and on the voucher there should appear the purpose for which the money is to be spent.

"Regarding the question of whether it will be necessary for the sheriff to publish in newspapers of general circulation in the province all the notices of attachment, attention is invited to the fact that this is not always necessary. It depends on

the kind of property for sale, according to section 454 of Act No. 190, otherwise known as the Code of Civil Procedure, which provides briefly as follows:

"Before sale, notice thereof must be given:

1. *Perishable property.*—Posting written notice of time and place on three public places.

2. *Other personal property.*—Posting similar notice in 3 public places.

3. *Real property.*—(*a*) Posting similar notice in 3 public places and (*b*) publication once a week in some newspaper published or having a general circulation in the province concerned.

"As may be seen from the foregoing, the publication in a newspaper is not indispensable, especially in case where very small amounts are involved. This office thinks that by merely posting of written notices of the time and place of sale in three public places, the law would be complied with."

(*Letter, December 13, 1926*)

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19. NO NEW DIRECTOR CAN BE APPOINTED BY THE BOARD UNLESS THERE IS A VACANCY. (THE SECRCETARY, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, SANTA IGNACIA, TARLAC.)

"As a general rule, a majority of the members of a board of directors form a quorum authorized to perform any corporate act of said board, and the appointing of a member, in case of a vacancy, is corporate business which can be legally attended to by said body. (Section 33, Act No. 2508, as amended.)

"The fact which should be established, however, before any action can be taken on this respect, is whether or not there is a vacancy on the board of directors. In your case, legally, there is not yet any vacancy to fill.

"We would therefore suggest that the absentee members be asked whether they would rather have a temporary leave of absence while attending to their personal interest or definitely resign and leave the board of directors at liberty to appoint their successors. If they ask for temporary leave, the remaining members of the board of directors, if they constitute a quorum, may select other persons among the shareholders who are capable of performing the duties incumbent upon directors, and in case of a definite resignation, the board can appoint any worthy shareholders to take the place of the resigning directors, who will then hold the positions until the regular election takes place, or until their successors have been duly elected and confirmed in their respective offices."

(*Letter, June 15, 1926*)

20. THE PRESIDENT OF AN ASSOCIATION IS ITS DULY AUTHORIZED REPRESENTATIVE TO ACT IN BEHALF OF THE ASSOCIATION. (MR. ANTONIO HABANA, CAPIZ, CAPIZ.)

"This office maintains that you, being the acting president of the association, although without the authority of resolution No. 142 of the board of directors in its meeting of January 5, 1925, are fully and legally authorized to represent the association in all cases in which it needs representation. It is fundamental in all corporations that the president of a corporation, or whoever acts in his place, is bound to enforce or cause to be enforced the provisions of the law, statutes, by-laws, and resolutions passed by the board of directors of the same, as well as to require the fulfillment of all the obligations contracted by its members with the same.

Furthermore, in view of resolution No. 142 of the board of directors, wherein not only are you, as president of the corporation, empowered, but each and every one of the directors also is empowered to act individually to collect the loans due the association, either through the court, or through the aid of a lawyer, it evidently appears that the allegation of the defendants in their answer to the complaint is untenable and out of place.

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21. A GENERAL DENIAL TO ALL THE CONTENTS OF A COMPLAINT CAN NOT BE SUSTAINED. (MR. ANTONIO HABANA, CAPIZ, CAPIZ.)

"The debtors in their answer to the complaint generally or specifically deny all the facts alleged in the same, a fact which seems to indicate that they deny not only your capacity to represent the association, but also the existence of the debt and the juridical personality of the corporation complainant. Any like allegation is equally untenable, because the corporation will be in a position to prove at any time that, prior to the date of the complaint, said Julio Azarraga, accompanied by his guarantors, Inocencio del Rosario and Joaquin Adrias, signed a promissory note and in fact received a certain amount from the rural credit coöperative association under the personal guaranty of the aforementioned guarantors, and that said amount, on the date of the complaint, had not yet been paid, in violation of the note signed by the aforesaid defendants.

(*Letter, February 1, 1927*)

22. THE PRESIDENT OF AN ASSOCIATION CAN NOT BE CONSIDERED RELIEVED UNLESS HIS SUCCESSOR HAS DULY QUALIFIED AS SUCH. (MR. ANTONIO HABANA, CAPIZ, CAPIZ.)

"With respect to this possible allegation of the defendants in effect denying your personality in the complaint, this office maintains likewise that the claim of the defendants is not based on any provision of law. Section 6 of the by-laws of the corporation clearly says the following:

SEC. 6. That the number of the directors of the said corporation shall be five and that the names and residences of the directors of the corporation who are to perform their duties until their successors are elected and qualified according to the provisions of the by-laws, . . .

"From the foregoing provision of the by-laws it is to be inferred that the mere election of a director does not confer any power to the elected if he does not qualify for the position for which he was elected. The directors who are performing their duties cannot leave their respective positions until after their successors have qualified in their office. Messrs. Manuel Arnaldo, Canuto Fuentes, and Jose M. Albar, in spite of their having been elected on December 10, 1923, did not take possession of their positions, and Messrs. Jose Hernandez, Antonio Habana, and Rufino Arcenas occupied their positions by virtue of the provisions of law and, according to the aforesaid article 6 of the by-laws, cannot leave their office until after those elected to take their places have been legally inducted into office.

(*Letter, February 1, 1927*)

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23. THE DOCTRINE OF ESTOPPEL MAY BE APPLIED. (MR. ANTONIO HABANA, CAPIZ, CAPIZ.)

"If the defendants made any effort to obtain from the actual board of directors on or before the date of the election held on the 10th of December, 1923, either an extension of time or for some other that, regarding the payment of their debts, they would not be able to deny the authority of any member of the actual board of directors, for the simple reason that said defendants had once recognized the authority and personality of the actual board of directors, and consequently could not later on deny that very same authority."

(*Letter, February 1, 1927*)

24. TRANSFER OF SHARES WHEN THE CERTIFICATE OF STOCKS WAS LOST. (THE MUNICIPAL TREASURER, SANTA CRUZ, DAVAO.)

"It appears that Mr. Lim Kio bought five shares of stock sometime before the incorporation of your association, for which you issued in his favor Official Receipt No. 6033247 in the sum of ₱25. This official receipt should have been surrendered by the depositor in order that it might have been exchanged for the corresponding Stock Certificate, Municipal Form No. 56(A), as in fact on October 4, 1920, you issued Stock Certificate No. 297843 for ₱25 in his favor. This certificate has never been received by said shareholder, though same has been detached from its stub and is supposed to have been sent to him. Mr. Lim Kio, in spite of the loss of his certificate of stock, is a duly registered member of the association. Now he desires to transfer his rights as a member to another person and the proper procedure is as follows:

"In the first place, Mr. Lim Kio should make an affidavit stating all he knows about the matter, and that he desires to transfer his rights in the certificate to another person, mentioning the name of the transferee. Then he should present this affidavit to you together with the official receipt he actually possesses duly indorsed on the back thereof to the person to whom he desires to transfer his rights thereon.

"This affidavit should be submitted to the board of directors for consideration, and if this body approves the transfer, a resolution to that effect should be adopted. The affidavit, together with a copy of the resolution of the board, should then be referred to you for notation in your books.

"Next, you are to attach the official receipt and the copy of the affidavit to the stub of the certificate that is supposed to have been lost, with a notation that the original was cancelled. Then a new certificate is to be issued in favor of the person to whom the transfer will be made, and if the transferee is not a shareholder yet, he must be required to pay the necessary admission fee. Even if he is an old member he must be required to pay the transfer fees required in section 22 of Act No. 2508. These fees should, however, be fixed by the board of directors in their resolution approving the transfer made by Mr. Lim Kio in favor of another."

(*Letter, March 30, 1927*

25. CHARGING OF COMPOUND INTEREST IS ILLEGAL. (TREASURER, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, MUÑOZ, NUEVA ECIJA.)

"If it is true that the association charged 10 per cent compound interest, instead of simple interest, on the ₱200 loan of Mr. Eusebio Mendoza, due June 22, 1922, as stated in his foregoing copy of letter, this office holds that the collection of said compound interest is illegal and contrary to law, for it exceeds the 10 per centum per annum allowed by section 12 of Act No. 2508.

"It may be alleged by the board that it charged compound interest on the loan in question because, had Mr. Mendoza paid on the date it fell due, at least the advance interest on his loan could have been given by the association to another member, and thus also earn interest. This office is inclined to believe that the failure of Mr. Mendoza to pay the advance interest on his loan on time was partly due to the neglect on the part of the board of directors, who perhaps also failed to require the borrower to pay said advance interest, and extend the time for payment of his loan another year if he was really unable to settle his account in full at the time it fell due. But whatever the reason may be, the association has no right to collect interest exceeding 10 per cent per annum.

"In view of the foregoing, it is requested that the treasurer be ordered to charge Mr. Mendoza 10 per cent simple interest only on his loan, and refund to him whatever amount in excess on that ₱300.22 he claims was collected from him as capital and interest on his loan."

(*Indorsement, January 15, 1927*)

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26. THE FOUR MEMBERS OF THE BOARD OF DIRECTORS CAN ELECT FROM AMONG THEMSELVES A PRESIDENT. (TREASURER, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, PAGSANJAN, LAGUNA.)

"Inasmuch as the president of your agricultural credit coöperative association is now sick and cannot attend to the corporate business of same, the four members of the board who constitute a quorum can elect from among themselves a president pro tempore who will take the place of the sick president until the date for the general election of the new officers of the association comes. All directors are of the same rank; they elect one of their members as president, he has no special au-

thority or appointment. If for any reason one of the remaining four members of the board cannot attend the meeting, or is absent from the town, the three members left would constitute a quorum as per section 33 of Act No. 2508, and could dispatch business, they should elect a president pro tempore from among themselves. Please convey this information to the members of the board of directors in order that they may act at once and ask them to notify you who the interim president is who will sign the vouchers with the secretary."

(*Letter, August 5, 1926*)

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27. THE ELECTION OF FIVE DIRECTORS INSTEAD OF TWO IN AN EVEN-NUMBERED YEAR IS ILLEGAL. (BOARD OF DIRECTORS, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ARAYAT, PAMPANGA.)

"Section 32 of Act No. 2508 provides that two directors shall be elected each even-numbered year and inasmuch as five directors were elected in the said meeting, it is therefore obvious that the said section was not complied with and the result is of no effect."

(*Letter, October 22, 1926*)

"In my letter to you dated October 22, 1926, which annulled the special election held on September 25, 1926, for reasons set forth therein, it was expressely declared that the regular election provided for in the by-laws of said association for the second Tuesday of November (November 9, 1926, in this case), be called and held for the purpose of electing two directors only, in substitution for those two who are required by law to cease holding office as soon as their successors have been duly elected and qualified. This request of the Director of Agriculture is but proper and legal, as sections 32 and 36 of Act No. 2508 as amended, and section 5 of the by-laws of the Arayat Association, require the yearly holding of a regular election of the stockholders' general assembly for the purpose of electing two directors every even-numbered year and three directors every odd-numbered year.

"It appears, however, that in the meeting held on November 9, 1926, for the purpose of electing two new directors, the stockholders, instead of electing two directors as stated in the notice of the meeting and as ordered by the Director of Agriculture, elected five, who, according to them, would constitute a new board of directors.

"Let me illustrate to you wherein lies the illegality of the election, and the impropriety of the procedure followed in accomplishing it.

"It is a general rule in an election that before any one can be elected to any office, said office must exist, or if said office exists, it must be vacant at the time the election to fill it is conducted. The evidence we have on hand shows that at the time of election, only two places in the membership of the board of directors were vacant, and in fact said election was called and held for the purpose of filling them. The evidence also shows that three members were occupying regular positions on the board at the time of the election. The minutes of said meeting signed by Pedro G. Tan as chairman, and attested by Ignacio Henson as secretary, do not show that the three other positions on the board were vacant, for in order that they could be declared vacant, there must have been previous resignations, deaths, or removal from office. Since none of these took place, the three members of the board were still members at the time the election took place, and consequently their places could not have been legally filled at the meeting. The minutes do not also show that they had been removed from office for cause, or if removed at all, that two-thirds of the members present voted for their removal. The three old members of the board of directors, therefore, could not have been replaced at the said election, and consequently the three new ones among the five elected cannot be considered legally elected.

"It may be well to determine also whether or not the election of the two directors among the five elected could be considered legal and consequently if they are legally qualified to fill the two vacancies in the membership of the board. It is a fundamental rule in an election that whenever there is doubt as to the will of the electorate, or whenever there is difficulty in determining to what office a certain officer has been elected, the election may be declared null and void. In the present case, it is very evident that it would not be possible to determine which two among the five directors elected, were intended by the stockholders to occupy the two vacancies in the board. This being the case, and in the absence of a specific rule for deciding cases of this kind, it is believed that this irregularity would constitute a sufficient cause to declare the entire election null and void. It is also a fundamental rule in an election that whenever any entity fails, for some reason or other, to elect

its officers in the stated general election, or whenever the officers so elected fail to qualify for the offices to which they have been elected, a special election may be called and held for the purpose.

"In view of the foregoing considerations, I hereby declare said election null and void and of no effect."

(*Letter, November 29, 1926*)

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28. THE USE OF PROXIES IS NOT A COMMON-LAW RIGHT, AND UNLESS IT IS CONFERRED BY THE BY-LAWS OF THE CORPORATION, SUCH RIGHT CAN NOT BE EXERCISED. (BOARD OF DIRECTORS, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ARAYAT, PAMPANGA.)

"In the same election fifty-seven proxies were used. In order that the right to vote by proxies may be allowed, it must be conferred either by statute, charter or the by-laws of the corporation. A right to vote by proxy is not a common-law right, and hence not necessarily incident to the shareholders in a corporation. There being no express provision in Act No. 2508, nor in the by-laws of the association nor any legal implication by which proxies in any election may be admitted, it is therefore clear that a right was exercised which did not exist."

(*Letter, October 29, 1926*)

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29. THE GRANTING OF A LOAN WITHOUT SUFFICIENT SECURITY BEING REQUIRED IS ILLEGAL, AND THE DIRECTORS WHO APPROVE SAID LOAN ARE JOINTLY AND SEVERALLY RESPONSIBLE THEREFOR. (BOARD OF DIRECTORS, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, MASANTOL, PAMPANGA.)

"In granting said loan in favor of Mr. Aureliano Dizon, on the sole guaranty of a certain Proceso Bustos, of Macabebe, Pampanga, the directors violated the following legal provisions:

SEC. 5 of the uniform by-laws which provides:

"* * * The directors * * * shall also approve or disapprove applications for loans. *Shall examine the guaranties offered and determine whether they are sufficient to secure the interests of the association,* * * *."

Sections 6 and 7 of Act No. 2508 which provide:

"SEC. 6. The credit operations of these associations must be witnessed by a promissory note or other document, signed by the applicant for the loan and accompanied by a personal, or pignorative security or mortgage upon real estate."

"SEC. 7. Personal security shall consist in a bond signed by two or more persons of recognized solvency in the municipality concerned."

"The directors violated section 5 of the by-laws, because they approved the application for a loan of Mr. Aureliano Dizon, knowing absolutely that it was neither guaranteed by a personal or pignorative guaranty nor by a mortgage upon real estate sufficiently legal, as is required by Sections 6 and 7 of Act No. 2508, the only guaranties legally acceptable by the association. The directors violated Section 7 of Act No. 2508 because they approved the application for a loan of Mr. Aureliano Dizon, knowing absolutely that it was guaranteed only by the personal guaranty of *one person,* who at that time was not a resident of the municipality of Masantol, and they equally violated the provisions of the said section, in having accepted the exclusive guaranty of Mr. Proceso Bustos, knowing as they must have known that the said kind of guaranty was not receivable by the association, and it being evident as it must have been evident to them that Mr. Bustos, though solvent, was not a resident of the municipality of Masantol, Pampanga, but of Macabebe, Pampanga.

"It is true that according to decisions handed down by the Supreme Court in various cases similar to this, Mr. Bustos who stood then as the sole and exclusive guarantor of the debt of Mr. Aureliano Dizon, cannot avoid the responsibility he voluntarily and knowingly assumed when he signed the bond, on the ground that he himself could be estopped if he intended to allege that his previous act was not legal when he himself recognized that it was legal; but acknowledging the fact that Mr. Proceso Bustos is now imprisoned by virtue of the penalty imposed on him by our tribunal in a murder case, it becomes impossible for the rural credit coöperative association to file a civil action against such a guarantor in the Court of First Instance of Pampanga.

"For the reasons above stated, the illegality of the acts of the directors who voted in favor of the loan in question having been patently demonstrated, there is no other possible remedy than to enforce the provisions of Section 35 of Act No. 2508, which makes them jointly and severally liable for the operations effected in violation of the by-laws or resolutions of the general assembly. Only those directors who entered a protest at the time against the approval of the said loan, it was decided, shall be exempted from the joint and solidary payment of the outstanding debt of Mr. Aureliano Dizon to the Rural Credit Coöperative Association of Masantol, Pampanga."

(*Letter, June 27, 1925*)

30. NO LOAN CAN BE CONSIDERED EXTENDED, UNLESS IT HAS BEEN EXPRESSLY APPROVED BY THE BOARD OF DIRECTORS. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"The board of directors has power to grant extensions of loans but such power should, in every case, be exercised for the good of both the association and its members. The granting of said extensions is discretionary with the board, but the power should not be abused lest it jeopardize the funds of the association and, and make the members of the board liable for acts done by them within their power and in good faith. As a matter of practice it is the bounded duty of the board to investigate whether a member is honestly entitled to an extension. The member applying for an extension should prove to the satisfaction of the board that he has tried his best to repay his loan on time, but because of circumstances beyond his control has been unable to. These circumstnces may be such as failure of crops due to flood, drought, or because of destruction by pests.

"Section 15 of Act No. 2508, provides:

The period of duration of the loans shall not exceed one year, which period may be extended for a time not to exceed five years by annual extensions.

"It is very clear from this provision that loans can be extended for only one year at a time and in no case to exceed five years. It is therefore safe to conclude that only loans can be extended and never the interest. The application for an extension must be in writing and give all the reasons why such extension should be granted. When the board approves the same by resolution, then it is considered as extended for another year."

(*Letter, August 4, 1927*)

31. THE ASSOCIATION HAS THE RIGHT TO CLAIM A PIECE OF PROPERTY WHEREVER IT GOES WHEN IT WAS DULY MORTGAGED AND THE DEED REGISTERED IN THE OFFICE OF THE REGISTER OF DEEDS. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"It depends upon how the property was mortgaged. If said property was mortgaged to the association and said mortgage was duly registered in the office of the register of deeds, the association has the right to claim said property wherever it goes. In many cases, the board of directors accepts a mortgage without registering same in the office of the register of deeds. This is not proper, because a promissory note signed by the borrower to that effect is no less than a mere unsecured 'pagare.'"

(*Letter, August 4, 1927*)

32. THE BOARD OF DIRECTORS CAN BE MADE TO ANSWER NOT ONLY FOR THE COMMISSION OF AN ACT BUT ALSO FOR AN OMISSION. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"The former board of directors that granted the loan can be made to answer for the same due to their negligence. A person can be made to answer not only for the commission of an act but also for an omission. As it is the duty of the board to exercise due care and diligence to protect the funds of the association it is therefore but proper and just to make the board responsible for the consequences of any of its acts, such as the negligence to collect the loan in due time.

(Letter, August 4, 1927)

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33. THE BOARD OF DIRECTORS HAS THE RIGHT TO ATTACH WHATEVER PROPERTY IS PLEDGED OR MORTGAGED TO IT. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"The present board of directors has the right to attach whatever property is pledged or mortgaged to the association to answer for loans granted to the members. Section 2 of Act No. 1459 defines a corporation as follows: 'A corporation is an artificial being created by operation of law, having the right of succession and the powers, attributes and properties expressly authorized by law or incident to its existence.' Some of the powers of a corporation as given by section 13 of the same act are:

1. Of succession by its corporate name for a period of time limited in the articles of incorporation and not exceeding the time prescribed by law.
2. To sue and be sued in court.
3. * * * And to exercise such powers and perform such acts as may be reasonably necessary to accomplish the purpose for which the corporation was formed.

"It is very clear therefore that a corporation has a continuous existence subject of course to the limitations prescribed by law.

"The procedure to be followed in this case is to file a complaint in the justice of the peace court for the recovery of the loan if said court has jurisdiction to try the case. The board of directors can ask for an attachment either before or after the judgment has been rendered by the court in favor of the association. As soon as the property has been attached, then a public auction may be held."

(Letter, August 4, 1927)

34. IF THE VALIDITY OF AN ELECTION IS NOT CONTESTED, SUCH ELECTION IS LEGAL. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"In case the election of the present board of directors is legal and in accordance with law and that the former board does not question its validity, but only refuses to deliver the books and other records to the new board, the present board of directors can institute a mandamus proceeding in the Court of First Instance praying that the former board be ordered to deliver all the papers and records belonging to the association."

(*Letter, August 4, 1927*)

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35. ANY PERSON ELECTED AS A MEMBER IS ELIGIBLE AS A MEMBER OF THE BOARD OF DIRECTORS. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"Any person once admitted as a member to the association has an absolute right to be elected as a member of the board of directors. The paying of the usual entrance fee may be done either before or after his admission as a member."

(*Letter, August 4, 1927*)

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36. A PERSON CAN BE A MEMBER BY A TRANSFER OF SHARES. (ANSELMO HEBRON, MUNICIPAL PRESIDENT, CANDELARIA, ZAMBALES.)

"A person can become a member of an association also by a transfer of shares from another member duly approved by the board and recorded in the books of the association. One of the requisites is that said transfer shall be approved by the board of directors by resolution, and that the Certificate of Stock issued in the name of the transferor shall be cancelled and a new one issued in the name of the transferee."

(*Letter, August 4, 1927*)

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37. WITHDRAWAL OF SHARES REQUESTED BY A PERSON WHO IS NO LONGER A RESIDENT OF THE MUNICIPALITY WHERE THE ASSOCIATION IS LOCATED IS A FORCIBLE WITHDRAWAL AND SHALL BE APPROVED. (MUNICIPAL TREASURER, ARINGAY, LA UNION.)

"Regarding the withdrawal of shares, the law is very clear. Section 30 of Act No. 2508, provides as follows.

SEC. 30. Any member *may* withdraw from the association, to take effect at the end of the current association year only, if the application for withdrawal was made before the last quarter of the association year; if made later, it shall take effect at the end of the next following association year.

An outgoing member shall be entitled to the benefits to which he may have been entitled under the by-laws during the time of his membership

in the association; but an outgoing member shall not be permitted to demand the amount of the shares until the association shall have funds available therefor; *Provided, however,* That there shall not be appropriated, in any one month, for payment to retiring members and on account of their shares more than one-third of the total net receipts of the association; *And provided, also,* That the association shall be obliged to pay, as soon as it has funds available, members who have withdrawn and have not been paid, after the conclusion of the year in which they have withdrawn.

An outgoing member shall not be entitled to any participation in the reserve fund.

An outgoing member shall be liable for a proportionate share of the losses and obligations of the association for operations effected during the period of his membership.

"Though it may be inferred from the above provisions that the board of directors may either approve or disapprove any request for withdrawals of shares, yet this office has ruled that there are cases of what we might call "forcible withdrawals" that the board of directors must approve, when its discretionary vote will not apply. We refer to the following cases:

1. When a member dies; and
2. When a member has lost his right to enjoy the privilege of his membership.

"Regarding the first case, the law is also very clear. Section 28 of Act No. 2508 provides in part as follows:

SEC. 28. * * * The death of a member shall be considered a withdrawal from membership.

"Regarding the second case, the natural inference from the second paragraph of the above-mentioned section is that a member who has moved to another municipality can no longer enjoy his privilege as a member, and therefore he must be considered out of the association.

"The second paragraph of section 28, Act No. 2508, provides as follows:

Each member shall be a resident of the municipality in which the association is organized, and shall have the reputation in the locality of being honest and industrious.

"In the case of the Rev. Jose L. Brillantes, who is now living in Santa, Ilocos Sur, obviously it is clear that he being no longer a resident of Aringay, La Union, can not enjoy any benefit from the association there.

"In view of this consideration, this office is of the opinion that:

"(1) Rev. Jose L. Brillantes, not only has the privilege of withdrawing from membership according to law, but he also has

the right to withdraw his shares from your association because, by virtue of the second paragraph of section 28 of Act No. 2508, he has lost his right to enjoy the benefits and privileges of a member.

"(2) Because the withdrawal and repayment of his shares can not in any way affect the financial stability of your association.

"(3) Because you have no right to retain his money at your pleasure if you can not give him any benefit in exchange therefor."

(*Letter, July 25, 1927*)

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38. A DEPOSIT IS DIFFERENT FROM A SHARE. (SANTIAGO CORTES, GUMACA, TAYABAS.)

"It seems that the amount you claimed therein was not for a deposit but for shares; for your name was not included in the list of depositors furnished this office by the treasurer of this association.

"You know a deposit is different from shares. The former can be withdrawn at any time, after 30 days' notice, and upon surrendering the corresponding certificate of deposit, unless there was a special arrangement made with regard to its withdrawal, while shares can only be withdrawn with the approval of the board of directors concerned, they alone being empowered by law to act on this particular matter. The board is also likewise authorized to reject any application for the withdrawal of shares if in its belief the reason given by the owner do not seem to justify such action, as shares are the foundation on which an association stands."

(*Letter, January 5, 1927*)

"It seems that the sum of ₱40 claimed in the foregoing letter of Mr. Santiago Cortes is not for a deposit, but for shares; for his name is not included in the list of depositors furnished this office by the treasurer. If the money was really a deposit, the approval of its withdrawal by the board of directors is not necessary. The money can be paid over by the treasurer, together with the interest due, if any, upon the owner's surrendering the corresponding receipt or cash deposit certificates. However, if it is for shares, the repayment of same should be approved by the board, who should first find out whether the reason given by the applicant to withdraw same justifies the

withdrawal. Shares are the foundation on which a rural credit association stands and the return of same should only be made if the withdrawer is in great necessity or has moved to another municipality, or has died."

(*Indorsement, January 5, 1927*)

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39. AN ASSOCIATION SHOULD REQUEST THE COURT TO APPOINT AN ADMINISTRATOR OF THE ESTATE OF A DECEASED BORROWER BEFORE SUING HIS ESTATE. (FRANCISCO RAMOS, GUMACA, TAYABAS.)

"To collect a dead man's debt, a complaint need not be filed against his heir. If a commissioner of claims has been appointed or an administrator has been named by the court, the association should present its claim to this party. If none has been appointed, the association should request the court to appoint one, on the ground that the deceased has left unpaid legal debts. The association then should present proof of indebtedness only, which is not disputed ordinarily."

(*Letter, April 26, 1927*)

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40. AN ASSOCIATION IS EXEMPT FROM THE PAYMENT OF FEES TO COURT. (FRANCISCO RAMOS, GUMACA, TAYABAS.)

"In connection with the legal action above suggested, this office is of the opinion that the association is exempt from paying any court fees, because the action to be brought is nothing but a preliminary step to enforce the payment of the obligation contracted in favor of the association. (See subsection (*d*), section 42, of Act No. 2508.)"

(*Letter, April 26, 1927*)

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41. A WIDOW CAN NOT SELL HER DECEASED HUSBAND'S PROPERTY WITHOUT SHOWING HER TITLE OR RIGHT TO SELL IT. (FRANCISCO RAMOS, GUMACA, TAYABAS.)

"If the property in question was truly the property of the borrower, his widow can not sell it, because she has no title to it, and any such sale is null and void. If her late husband, before his death, sold this particular property to his wife and the deed of sale was duly registered, then his wife has prior right to the property and can dispose of it at any time. The procedure to follow is the same as set forth in the answer to Question No. 1, so that the widow can be forced to show her title or right to sell the property."

(*Letter, April 26, 1927*)

42. MORTGAGE SHOULD BE REGISTERED. (FRANCISCO RAMOS, GUMACA, TAYABAS.)

"The association should see that the deed of mortgage is drawn up on a regular form and registered in the office of the register of deeds. No expense will be incurred in registering any instrument of this nature, the association being exempt from paying any fees for that purpose, under subsection (*e*), section 42, of Act No. 2508."

(*Letter, April 26, 1927*)

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43. THE SPENDING OF AN ASSOCIATION'S FUND WITHOUT A DETAILED STATEMENT OF THE NATURE OF THE EXPENDITURE IS ILLEGAL. (PRESIDENT, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, KAWIT, CAVITE.)

"By virtue of section 43 of Act No. 2508, as amended by Act No. 2566, the Director of Agriculture issued on February 28, 1921, a circular letter which was approved by the Secretary of Agriculture and Natural Resources, the preamble of which partly reads as follows:

To insure uniformity and a clear understanding by the members, the directors, the treasurers, the district auditors, and the rural credit agents, the following rules are issued covering the general question of the SPENDING OF ANY FUNDS and distributing dividends of any association:

"And the rule which applied to the case at issue has been openly infringed by the acts of the Kawit Agricultural Credit Coöperative Association quoted hereunder:

III. No association money shall be SPENT for secretary allowances, other salary expenses, or per diems, etc., without the written permission of the Director of Agriculture. * * *.

"In another part of the preamble of the afore-mentioned circular, the attitude of this office towards the refractory associations has been defined as follows:

If an association desires to enjoy the benefits of the exemptions and privileges of Act No. 2508 it must also conform to all the conditions of that law. If, however, it wishes to be independent of supervision and SPEND ITS FUNDS, EARNINGS, OF PROFITS as it wishes, it must renounce these privileges and operate under the internal revenue rules.

"This office disapproved the spending of ₱300 of association funds by the directors without a detailed statement of the nature of the expenditures and the authority of this office."

(*Indorsement, April 27, 1927*)

44. THE ENTIRE PREMIUM ON THE BOND OF THE TREASURER OF AN ASSOCIATION IS CHARGEABLE AGAINST ITS GENERAL FUND. (PROVINCIAL TREASURER, BAYOMBONG, NUEVA VIZCAYA.)

"The entire premium on the municipal treasurers' additional bond in the Fidelity Fund in their capacity as ex-officio treasurers of the agricultural credit coöperative associations is chargeable against the general fund of the association. No portion of it is to be paid by any other party."

(*Indorsement, August 26, 1927*)

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45. WHEN THE PRESIDENT VOLUNTARILY RESIGNS FROM HIS OFFICE, THE FOUR REMAINING MEMBERS ARE EMPOWERED BY LAW TO APPOINT A NEW DIRECTOR AND TO ELECT FROM AMONG THEM A NEW PRESIDENT. (BOARD OF DIRECTORS, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, IUISAN, CAPIZ.)

"It is understood that Mr. Advincula, from the date of his resignation, has entirely ceased his connection with said board, so the remaining four members of that body are therefore empowered to designate one of themselves to act as president of the association until the successor of Mr. Advincula has been duly elected in the next general meeting and qualified in his office."

(*Letter, December 21, 1926*)

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46. IF THE DIRECTORS HAVE APPROVED AN UNSECURED LOAN THEY WOULD BE HELD JOINTLY AND SEVERALLY RESPONSIBLE TO THE ASSOCIATION FOR THE AMOUNT LOANED. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, BALUNGAO, PANGASINAN.)

"It is indubitable and is not objected to that if the defendants had not asked for a voucher nor for a bond for the payment of costs, they would be held responsible for the obligation of the former according to section 35 of Act No. 2508."

(Decision laid down by Judge Buenaventura Reyes, Civil Case No. 2402—"The Rural Credit Coöperative Association of Balungao, Pangasinan, *vs.* Leon Mico, *et al.*")

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47. THE ASSOCIATION WHICH IN GOOD FAITH DELIVERED ANY AMOUNT TO A DULY AUTHORIZED COLLECTING OFFICER OF THE GOVERNMENT, IN CASE THE MONEY PAID SHOULD BE LOST, AFTER IT HAD BEEN DELIVERED AND RECEIPTED FOR, CAN NOT BE MADE TO PAY AGAIN. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, TIWI, ALBAY.)

"The whole story of this controversy dates back to December 9, 1920, when Mr. Jose Tomas in his capacity as *municipal treasurer* of Tiwi, Albay, packed up a bundle of paper money

to the amount of ₱800 and deposited it in the mail *after having registered same.* The money was duly credited in the books of the association, but was stolen by the mail-carrier while in transit. The thief was caught, and found guilty by the court.

"The Tiwi Rural Credit Association did not know anything about the loss of the money until it received various letters from the Department of Agriculture and Natural Resources, demanding the payment of said amount, but all the members knew perfectly well that the board of directors had passed a resolution ordering its treasurer to pay it, and that the money had been paid."

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"The corporation money was held in trust by a Government bonded official, and the sum of ₱800 was duly and carefully placed in the care of the Government as registered mail for delivery to another branch of the Government. If neither the treasurer nor the Government is responsible for the loss of the money entrusted to both of them, and if the people, after all, are the ones who are to be held responsible for the loss, then what degree of confidence can we expect the people to have in the Government?"

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"The only question, therefore, to be decided is who is primarily liable. The facts as analyzed above clearly show that the Rural Credit Association is not in fault at all. No negligence can be attributed to it. It paid its debt in the only way it could—handling the money over to the municipal treasurer, the *legal depositary* for Government funds, and from that moment, it is contended, the association was free *from any obligation to see whether the money was properly cared for or not.* He mailed the money and it has already been shown that it was lost through the fault and negligence of persons entrusted by the Government to look after the mails. The Government may be held to account for it under article 1902 of the Civil Code, which provides:

> Any person who by an act or omission causes damage to another by his fault or negligence shall be liable for the damage so done.

"The Government is primarily liable in this case and as such it should stand the loss, without prejudice to its right of action against the person or persons directly responsible for the loss of money, it is believed.

"To reason otherwise is to establish the precedent that a debtor cannot pay his debts by registered mail; that where there is no bank a debtor must journey to the place where his creditor lives to pay him, which is a manifest absurdity and tantamout to saying that the *U. S. Postal system* is a *self-confessed irresponsible carrier.*

"It must be borne in mind, that the treasurer of the said association, the municipal treasurer of Tiwi and the postmaster of Tiwi are one and the same person. Because of this, the Insular Auditor wants to emphasize the fact that when the municipal treasurer received and forwarded the ₱800, he acted only as the treasurer of the association and not as a municipal treasurer. It is believed that this assertion is not sound and will not hold good in this particular case. By the time the money was given to him as payment of the association, he automatically became again a municipal treasurer and as such he acted as the representative of the Government.

"Whether he is liable as a municipal treasurer or as a postmaster, it is for the Government to see, and it is for the Government primarily to make good the loss made by him while acting as a representative of the Government.

"The association, therefore, cannot be blamed for the loss. It had complied with its obligation in a proper and in a most convenient way. It had paid its debt to the representative of the Government, who became responsible for it at the moment he received it, as such.

(*Indorsement, October 6, 1921*)

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48. TRANSFER OF SHARES OF AN ABSENT MEMBER TO ANOTHER PERSON. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ..., ...)

"With regard to the first point we invoke the general provision which governs the case contained in section 25 of Act No. 2508 which runs thus:

SEC. 25. The shares shall be registered and shall not be deemed transferred, mortgaged, or pledged without the consent of the board of directors.

"So that in order to comply with the request of the applicant in this case, who is the wife of the shareholder absent abroad, it is necessary that the true holder of the shares to be transferred endorse his shares to his wife.

"It is a legal requisite for the transfer of shares in favor of another person that the signature of the shareholder shall appear on the back of the certificate of the shares and approval of the President and Secretary of the Association, and then, as a consequence of said procedure, the cancellation of the original title of the shares and the issuance of a new title in favor of the new shareholder."

(*Letter, October 20, 1926*)

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49. THE DEATH OF A MEMBER IS CONSIDERED AS A WITHDRAWAL FROM MEMBERSHIP. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ..., ...)

"With respect to the second case, we answer that the death of a member is considered as a withdrawal of the same according to section 28 of Act No. 2508.

The death of the member is one of the automatic withdrawals which the board of directors approve.

"In the present case, it is seen that the intention of the widow was not to withdraw the shares of her dead husband, but simply to subrogate herself to the rights of her husband, with respect to the shares of the latter in the association. The claim of the wife is legal, but it is necessary to establish, before approving the transfer of the shares of the deceased in favor of his wife, the necessary proofs that the member really died and that the petitioner was the legitimate wife and is the universal heiress or the administratrix of the estates of the deceased.

"Though the law, in order to establish these proofs beyond doubt, requires many things, which sometimes do not pay the expense incurred in obtaining them, considering the value of the shares the transfer of which is requested, this office believes and is of the opinion that the board of directors of the association can make use of easy means, and without any expense, to ascertain the truth of the facts which in a direct or indirect way may put in doubt the legitimacy of the claim of any shareholder, who is the widow of the deceased member in the present case.

(*Letter, October 20, 1926*)

50. VOTING BY PROXY IS NOT PERMISSIBLE UNLESS THE RIGHT IS EXPRESSLY CONFERRED BY THE BY-LAWS OF THE ASSOCIATION. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ..., ...)

"The third question can be answered by simply saying that it is not permissible within any coöperative association. Though it is true that the Corporation Law allows or authorizes the casting of votes by proxy inasmuch as in a coöperative association it is provided for by section 29 of Act No. 2508 that "each member shall have only one vote regardless of the number of shares held by him, this seems to simply that the votes by proxy ought to be restricted.

"It is a well-known rule that to vote by proxy is neither a common right nor inherent in a member. If a corporation desires to allow or authorize votes by proxy, it is a necessary condition that its by-laws provide for that particular thing. It is not enough that the general law has so provided in order that every corporation may or may not follow it. It is necessary that its by-laws and regulations may contain express provision over this particular.

"Besides, the principle that in the rural credit coöperative association not all the people can be shareholders must be taken into account. The board of directors is empowered by the Act to approve or deny the petition of any person to become a member if it has reason to do so, which shows that the association does not open its doors to all the people nor allow the persons who do not fulfill the necessary conditions to become shareholders to intervene in the deliberations of its corporate affairs. Should we open the doors of the association to any person and permit him or her to take part in the deliberations of our affairs, either because he or she is empowered to represent an absent member, this would be tantamount to permitting even those who are against the idea of rural credits to take part in the affairs that would not affect them personally.

"The shares in rural credits are personal and untransferable, to a certain extent, and no member can cast more than one vote; this is the general rule. If they are intransmissible, it logically follows that the vote by proxy is not permissible, because this implies a transfer or delegation of the rights of the shareholder in favor of another person, an act which is in open

contravention to section 25 of the Act. If no one of the members is allowed to cast more than one vote, it logically follows that to vote by proxy is not permissible, because this would permit a representative who has the authority to represent more than one member to have more than one vote.

(*Letter, October 20, 1926*)

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51. NO SHARE CAN BE SOLD, DONATED OR GIVEN TO ANOTHER PERSON WITHOUT THE CONSENT OF THE BOARD OF DIRECTORS. (AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, ..., ...)

"The fourth question is not permissible, within the meaning of section 25 of Act No. 2508. When it is said that the shares 'cannot be mortgaged nor pledged without the consent of the board of directors' it is clear that no shareholder shall have the right to 'alienate, donate to or bestow upon as dowry' his shares to any other person without the consent of the *board of directors*."

(*Letter, October 20, 1926*)

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52. DIRECTORS ARE DEBARRED FROM VOTING ON A REMUNERATION FOR THEMSELVES. (BOARD OF DIRECTORS, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, IRIGA, CAMARINES SUR.)

"Resolution No. 40 voting out ₱12 for a member of the board of directors who was one of the three directors who constituted the quorum in a particular meeting appears to have been approved by the votes of three directors, Santiago Gonzales, Isaac Morallo, and Dionisio Ordaz, himself.

"Section 11 of Act No. 2508 provides:

No director shall vote on a loan requested by him for himself or any member of his family, natural or by affinity, to the third degree, or applied for by any member of his family, natural or by affinity, to the third degree, nor on a loan requested by any person who owes a debt to him or to any member of his family; nor shall he become bondsman, surety, or indorser of any loan contracted with the association.

"Last clause of section 33 provides:

Provided, That no loan shall be made except by affirmative vote of at least three members of the board.

"After a careful perusal of this case, in connection with the provisions of the above-quoted sections of the law, any one will have to conclude that the law prohibits the voting out of any sum in favor of any member of the board of directors, without the affirmative vote of three disinterested directors. Granting that Dionisio Ordaz refrained from voting in the approval of

resolution No. 40, it would then appear that said resolution was approved by the votes of two directors only; namely, Santiago Gonzales and Isaac Morallo, which number is, in the opinion of this office, not sufficient to validate said resolution.

"Since the law debars a director from voting to grant a loan to any member of his family, with more abundant reason the law would have to debar him from voting a gift for himself.

"If three affirmative votes are needed to approve a loan, with more reasons, a gift ought to be approved by three affirmative votes at least."

(*Indorsement, August 29, 1927*)

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53. THE ASSOCIATION SHOULD NOT ENGAGE ITSELF IN ANY SPECULATIVE BUSINESS. (MUNICIPAL TREASURER, SAN NICOLAS, ILOCOS NORTE.)

"In answer to your letter of the eighth instant, asking whether it would be feasible for the association to accept, in payment for a debt of a borrower against whom a judgment was handed down by the court, a piece of real estate valued at about two-fifths more than the total obligation, and to lease it to someone at a possible monthly rental of one and a half per cent of the total indebtedness, I have the honor to inform you as follows:

"Though the proposition might look somewhat profitable to the association, yet it would not be advisable for the association to engage in any speculative business.

"It is not possible for a rural credit association to own real estate permanently as the law specifically provides, under section 24 of Act No. 2508, that in case the title of ownership of any property has been adjudicated to an association, this can not possess it more than three years.

"It must also be borne in mind that the law only authorizes the association to purchase any property at any public or private sale whenever the association has a mortgage, judgment or lien or any other incumbrance thereon, or in which it has any property interest. It is therefore implied that the association can not buy the property offered by the debtor in the case at issue, unless the sheriff sells it at a public auction, a judgment having been rendered against it by the court.

"It may be true that the assessed value of the property in question is two-fifths more than the total obligation of the owner, but if it is forcibly sold at a public auction, it may not be adjudicated at the same price, especially when there are no other bidders than the association.

"The opinion of this office, therefore, is that the judgment of the court must be enforced, and when the sheriff proceeds to sell said property at auction, let the association enter a bid and try to get it at as low a price as possible with a view to making it marketable any time. If the proceeds of the sale are not sufficient to cover the whole indebtedness, then the association would have the right to sue the bondsmen, if there are any. It will not be proper for the association to enter into any extra-judicial transaction with the debtor after the case against him has been finally adjudged."

(*Letter, September 12, 1927*)

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54. WITHDRAWAL FROM MEMBERSHIP IS NOT A RIGHT; IT IS A MERE PRIVILEGE. (ANDRES RIVERO, BUREAU OF LABOR, MANILA.)

"Section 30 of Act No. 2508 provides:

> Any member may withdraw from the association, his resignation to take effect at the end of the current association year only, if the application for withdrawal was made before the last quarter of the association year; if made later, it shall take effect at the end of the next following association year.

"The legal construction of this article is that a member of any rural credit coöperative association differing from other corporation shareholders, has the privilege of withdrawing his shares, and for this reason the word 'may' is used in the English text of the law which means 'discretion or probability.' The text of the act wherein the same word is used shows that the act is not potestative on the part of the one who executes it, but it depends upon the one who allows or authorizes it. In the present case, it is seen that the member is given the privilege of withdrawing from the association whenever the board of directors believes that the withdrawal of his shares will not particularly affect the economic stability of the association.

"This interpretation has been assailed by many, but in practice it has been seen that it has to be this way to prevent the dissolution of the association if a majority, if not all, of the shareholders holding a great number of shares should decide to withdraw from the association, more particularly, when it (the association) has incurred any obligation to the Insular Government or against any particular entity, like the National Bank. Wherefore, the withdrawal by the members of their shares ought to be subject to the approval or disapproval of the board of directors, as otherwise the stability of an association would be in danger.

"Now, then, in the event that the board of directors authorizes the withdrawal of the shares of a member, as in many cases happens, the shareholder would have to wait until the end of the current year, if the application is made before the last quarter of the current year, and to the end of the next following year if the application for withdrawal is made after the month of September."

(*Letter, April 11, 1927*)

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55. NO MEMBER CAN FORCE THE ASSOCIATION TO REPAY HIM FOR HIS SHARES UNLESS THERE ARE SUFFICIENT FUNDS. (ANDRES RIVERO, BUREAU OF LABOR, MANILA.)

"The second paragraph of the same section provides among other things:

But an outgoing member shall not be permitted to demand the amount of his shares until the association shall have funds available therefor: *Provided, however,* That there shall not be appropriated, in any one month, for payment to retiring members and on account of their shares more than one-third of the total receipts of the association . . .

"Otherwise it is inferred that the time in which the retiring member has to wait could not be determined, because this depends on the monthly receipts of the association."

(*Letter, April 11, 1927*)

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56. THE NEGOTIABILITY OF THE SHARES IS RESTRICTED. (ANDRES RIVERO, BUREAU OF LABOR, MANILA.)

"They are negotiable to a certain extent, because they are a deed of value and because the same can be offered as a guaranty for a loan from the association asked for by the owner himself, but the negotiability of the said shares ought to meet the approval of the board of directors because the same cannot be sold nor alienated nor transferred to other persons without the consent of the board of directors. The legal provision which governs this case is the following:

SEC. 25. The shares shall be registered and shall not be deemed transferred, mortgaged, or pledged without the consent of the board of directors.

"This provision is so important that every shareholder may consider that the shares of a rural credit coöperative association are not such negotiable papers in all the legal acceptation of the word. The reason is very simple. It is known that the shares of a rural credit association are sold only to those persons who according to section 28 of Act No. 2508 ought to be residents of the municipality wherein the association is organized and

enjoy the reputation of being honorable and industrious in the locality. Should holders of the shares be allowed to sell or alienate them, it might happen that the persons in whose favor the said shares had been sold did not meet the requirements specified in section 28 of the Act, and due to this defect, would not be recognized by the association when they present themselves in the general meeting of the shareholders in order to take part in the deliberation over the affairs affecting the association. In the same manner, they would not enjoy the rights and privileges which might have been enjoyed by their former owners. In the same way the shares of a rural credit association cannot be sold in the open market, as can the shares of other corporations. In the same way also it is required that they cannot be alienated, nor sold nor transferred to any other person without the consent of the board of directors.

(*Letter, April 11, 1927*)

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57. WITHDRAWAL OF SHARES FROM THE ASSOCIATION MUST BE RESTRICTED. (CECILIO L. MAGADIA, SECRETARY, AGRICULTURAL CREDIT COÖPERATIVE ASSOCIATION, CANDELARIA, TAYABAS.)

"* * * In any coöperative association in which the admission of members is based on their reputation, and not on the amount of shares they can buy, the retirement from membership must be restricted, especially when the withdrawal of shares would seriously impair the financial stability of the association. Hence, it has been ruled by this office that since the board of directors is empowered by law to approve or disapprove all applications for membership, that body is, by implication, also empowered to approve or disapprove all applications for withdrawal from membership."

(*Letter, September 15, 1927*)

PARA RUBBER IN BATAAN

By F. G. GALANG
Horticulturist

Different parts of the Philippines have more or less different soil and climatic conditions, which may or may not be favorable to the growing of Para rubber. The opinion seems to be unanimous, however, that it can grow in various kinds of soil provided they are well drained and with a uniform distribution of rainfall; and that it does not stand strong winds, as may be noted in Mindanao and in the rubber-producing countries of the world today. There are no data so far that have come to the knowledge of this Bureau regarding the possibility of Para rubber in the typhoon belt both in regions with a well-distributed rainfall and in regions with a distinct dry and wet seasons. However, Para rubber might be just like other plants in a new environment, *i. e.*, it might adapt itself to the new surroundings. If spaced farther apart than is now customary, the plant would develop thicker and stouter trunk and well-balanced branches and so be better able to resist the force of the winds. To settle this question in the minds of the planters it is imperative to find out the suitability of this plant in each district of the Archipelago—more particularly in the typhoon belt where there is a distinct dry and wet seasons in order to preclude any failure from planting it on a commercial scale. This investigation is mainly, therefore, to solve this problem.

The Bureau of Agriculture has no rubber plantation of its own in which to conduct such an investigation at present. In order to carry on the work contemplated we began to search the Bureau of Agriculture records to see to whom the Para rubber seeds and plants were distributed years ago, especially in the island of Luzon, so as to find out what the yield of Para rubber in those districts has been.

Yield data are now being gathered from the Para rubber trees in Abukay, Bataan; in Baco, Mindoro and in Putiao, Sorsogon. The results reported hereunder are only for a year in Bataan.

CLIMATE AND SOIL

Bataan usually has two distinct seasons—the dry and the wet. The dry season begins in November and terminates in April and the rainy season begins in May and ends in October of each

year. The Abukay Plantation Company in Abukay, Bataan, where the Para rubber trees were planted, is situated about seven kilometers west of the town, at the foot of Mariveles Mountain. It has an elevation of about 600 to 700 feet above sea level. The plantation is protected from strong winds on the western and southern parts by the mountain and forest trees while the eastern and northern sides are exposed to the winds.

The surface soil is quite deep and of a brownish clay loam, and the subsoil is clayey with small stones in some portions of the plantation. The chemical and mechanical analysis of the surface soil and subsoil samples submitted by the Bureau of Agriculture to the Bureau of Science are given in Tables I and II.

TABLE I.—*Chemical analysis*

[Surface soil.—Water-free basis]

Loss on ignition	10.89
Nitrogen (N_2)	0.155
Phosphoric anhydride (P_2O_5)	0.128
Lime (CaO)	1.60
Potash (K_2O)	0.577
Humus	0.99
Soil acidity (per cent $CaCO_3$)	0.011

TABLE II.—*Mechanical analysis*

[Water-free basis]

	Surface soil	Subsoil
Coarse sand, 1–0.5 mm	0.9	0.7
Medium, 0.5–0.25 mm	7.3	4.8
Fine, 0.25–0.10 mm	21.9	14.8
Very fine sand, 0.10–0.05 mm	15.3	13.7
Silt, 0.05–0.005 mm	39.3	40.3
Clay, 0.003 mm	15.3	25.7

MATERIALS

The seeds for the Para rubber in Abukay are said to have been obtained from the Bureau of Agriculture through Mr. A. W. Prautch about 15 or 16 years ago. There are more 100 Para rubber trees growing in this plantation and they are planted along the sides of the ravines. Out of this number only 88 are being tapped because of the smaller size of the other trees. Originally the plants were distanced about 5 meters apart but since many of them died some of the surviving trees are now occupying a greater space than 5 meters. No cultivation except cutting down the weeds between the plants has been recorded from the start and even this was only done lately—when the

experiment began. Undoubtedly the trees are mostly undersized because they are jungle-checked and of slender growth. The trees were never tapped before although they have an average girth of 25.96 inches measured three feet from the ground taken on April 12, 1926, and a height of from 7 to 15 meters. The smallest girth of the tappable trees was 13.2 inches, while the largest tree was 43.8 inches in girth at the start of the experiment.

No serious diseases and pests were observed so far on the trees although quite a number of them have portions of their tappable bark loose from the trunk, due to the fires set during the clearing of the seeds between the plants. White ants were found to have attacked some of the trees, however.

METHODS

Tapping was done at an early hour of the morning in ½ spiral daily in alternate months. The latex coagulated by the addition of one part of the stock solution of acetic acid, which was made of 1 part acid to 20 parts water, to 50 parts of the latex. The coagulum was milled or pressed with the aid of a wooden pin and properly washed in fresh water before it was smoked or air-dried. Then the constant weight of the dry rubber was taken. The latex obtained from each tree was measured daily and the corresponding dry rubber of it was calculated from the total dry rubber of the latex produced in a day from all the trees. Coagulating the latex produced from each tree was not done separately because of lack of coagulating pans.

RESULTS

Table III shows the monthly yields from April 12, 1926 to May 15, 1927, together with the totals and the corresponding averages.

TABLE III

Date	Number of tree tapped	Number of tapping days	Yield of			
			Latex	Dry rubber in pounds from		
				Latex	Washing	Scrap
			Cu. cm.			
April 12 to May 11, 1926	88	30	57,713.9	42.72	5.05	5.79
June 15 to July 14, 1926	87	28	74,193.0	40.48	1.78	3.46
August 15 to September 14, 1926	82	17	50,669.5	25.25	1.38	1.54
October 16 to November 15, 1926	82	28	105,765.0	48.30	2.37	2.57
December 15, 1926 to January 15, 1927	80	27	95,991.5	53.23	2.00	2.44
February 16 to March 15, 1927	80	28	68,797.0	38.84	1.78	2.48
April 15 to May 15, 1927	81	21	37,600.5	23.38	1.56	2.66
Total	580	179	491,240.4	272.10	15.92	20.94
Monthly average	82.8	25.5	70,177.2	38.87	2.27	2.99

No tappings were performed because of rains during the following periods: June 17–18, August 15–23 and 29, September 9–12, November 6–7 and 12, December 20 and 27, 1926, and January 2, 1927.

On December 25, 1926 and January 1, 1927 the trees were not tapped either, these being holidays; nor May 6–15, 1927, for lack of acid.

As may be seen in Table III the yields obtained under Bataan soil and climatic conditions were as follows: 272.10 pounds of dry rubber produced from the latex, 15.92 pounds from washing, and 20.94 pounds of tree scrap from an average of 82.8 trees in 179 tapping days in alternate months. This makes a total yield of 308.96 pounds of dry rubber, which yield is comparable with the yields recorded in other countries, in spite of the fact that no care was taken of the trees and this was the first time that they had been tapped as before stated. The yield in other countries ranges from 206 to 402 pounds of dry rubber per acre as found during my investigation on rubber in those countries, and not to speak, of course, of the higher yield they obtained from their budded and selected trees. It should also be taken into consideration that 88 trees are too few for an acre of land of the present age of the trees, as in other countries it is considered that 100 trees should be left after the final thinning of the plantation, and 150 or more this age, probably.

The percentages of dry rubber of the total latex produced was 37.84 per cent.

Higher yields were obtained during the months of October, November, and December tappings, which was before the wintering period of the trees. Wintering in Bataan takes place in January and new leaves are developed in February and March, but the majority of the trees have their new leaves in February. April is the flowering month.

Table IV shows the individual tree yields from April 12, 1926 to May 15. 1927 and the girths of the trees taken April 12, 1926.

TABLE IV

Tree No.	Number of days actually tapped	Yield		Girth, 3 feet from the base	Remarks
		Latex	Dry rubber		
		(*Cu. cm.*)	(*Pounds*)	(*Inches*)	
1	171	5,580.0	3.52	22.5	Partly hacked.
2	177	10,088.5	6.35	33.4	Roots exposed, trunk partly burned.
3	178	13,750.0	8.66	29.6	Trunk partly burned.
4	178	3,538.0	2.23	25.2	Healthy.
5	178	2,292.0	1.44	16.3	Do.
6	178	6,387.0	4.02	26.8	Do.

TABLE IV.—Continued

Tree No.	Number of days actualy tapped	Yield		Girth, 3 feet from the base	Remarks
		Latex	Dry rubber		
		(*Cu. cm.*)	(*Pounds*)	(*Inches*)	
7	178	3,485.0	2.20	29.8	Roots exposed, trunk partly burned.
8	178	8,570.0	5.40	32.0	Trunk partly burned.
9	178	3,746.0	2.36	34.2	Healthy.
10	178	8,596.0	5.42	43.8	Trunk partly burned.
11	178	1,538.0	0.97	21.5	Healthy.
12	178	9,562.0	6.02	37.6	Do.
13	178	5,285.0	3.33	32.7	Do.
14	178	2,754.0	1.74	20.2	Do.
15	178	3,841.0	2.42	21.1	Do.
16	178	19,377.5	12.21	37.0	Healthy with exposed roots.
17	178	8,778.0	5.53	33.0	Do.
18	178	8,149.0	5.13	36.1	Healthy with exposed roots.
19	179	15,296.0	9.64	35.8	Do.
20	179	9,807.0	6.18	32.8	Do.
21	179	4,590.0	2.89	26.6	Hacked trunk and roots exposed.
22	179	3,442.0	2.17	25.0	Healthy with exposed roots.
23	179	6,508.0	4.10	27.0	Trunk partly burned and exposed roots.
24	179	13,499.5	8.50	34.0	Healthy with exposed roots.
25	179	2,650.0	1.67	25.9	Do.
26	179	2,904.0	1.83	27.6	Do.
27	179	6,643.0	4.19	23.7	Trunk partly burned and with exposed roots.
28	179	7,695.5	4.85	24.9	Trunk partly burned.
29	179	2,061.0	1.30	27.9	Healthy.
30	179	11,420.0	7.19	40.1	Healthy and part of roots exposed.
31	179	11,012.5	6.94	32.1	Do.
32	179	16,980.5	10.70	35.8	Do.
33	179	5,012.0	3.16	21.6	Trunk partly burned and with exposed roots.
34	179	1,843.5	1.16	19.9	Trunk partly burned.
35	179	9,270.0	5.84	25.8	Healthy.
36	179	6,971.5	4.39	18.9	Trunk partly burned and roots partly exposed.
37	179	5,314.0	3.35	21.2	Trunk attacked by white ants.
38	179	10,178.0	6.41	26.5	Healthy.
39	179	4,457.0	2.81	16.9	Do.
40	179	3,248.0	2.05	24.2	Do.
41	179	2,910.2	1.83	17.2	Healthy and part of roots exposed.
42	179	14,162.5	8.92	31.0	Do.
43	177	1,867.5	1.15	22.5	Do.
44	177	15,281.5	9.54	41.8	Do.
45	170	2,414.0	1.50	19.0	Trunk attacked by white ants.
46	179	7,903.0	4.93	20.7	Healthy and part of roots exposed.
47	179	13,098.5	8.17	32.7	Healthy.
48	179	4,383.0	2.72	16.4	Do.
49	178	3,945.0	2.49	20.5	Healthy and roots partly exposed.
50	178	5,624.0	3.54	24.5	Do.
51	178	3,113.0	1.96	29.2	Healthy.
52	178	6,766.0	4.26	27.0	Healthy and roots partly exposed.
53	178	9,043.0	5.70	23.8	Healthy.
54	178	4,103.0	2.58	26.0	Healthy and roots partly exposed.
55	178	5,335.0	3.36	28.5	Do.
56	178	1,949.0	1.23	22.4	Do.
57	178	2,899.0	1.83	24.1	Do.
58	178	1,424.0	0.90	19.5	Do.
59	178	13,120.0	8.27	35.4	Do.
60	178	4,536.0	2.86	19.4	Do.
61	178	3,014.4	1.90	25.2	Do.
62	178	5,317.0	3.35	21.4	Do.
63	178	2,322.5	1.46	16.3	Do.
64	178	4,784.0	3.01	23.7	Hacked trunk.
65	178	1,622.4	1.02	18.4	Healthy.
66	49	813.0	0.51	24.1	Trunk partly burned. Rested June 15–26 and finally died on August.
67	150	2,107.0	1.33	....	Trunk partly burned and roots partly exposed.
68	32	741.0	0.47	18.7	Trunk partly burned. Died in August.

TABLE IV.—Continued

Tree No.	Number of days actually tapped	Yield		Girth, 3 feet from the base	Remarks
		Latex	Dry rubber		
		(*Cu. cm.*)	(*Pouuds*)	(*Inches*)	
69	150	850.5	0.54	22.0	Trunk partly burned.
70	57	1,713.0	1.08	35.2	Trunk partly burned. Died in August.
71	57	934.0	0.59	24.6	Do.
72	57	1,334.0	0.84	35.2	Trunk partly burned and roots partly exposed. Died in August.
73	157	2,608.0	1.64	32.3	Healthy.
74	178	1,111.0	0.70	13.2	Do.
75	178	3,042.0	1.92	33.3	Do.
76	10	41.0	0.03	13.5	Healthy. Burned April 22 and died in June, 1926.
77	178	3,376.0	2.13	22.7	Healthy.
78	178	3,857.0	2.43	30.5	Do.
79	178	5,790.0	3.65	31.3	Do.
80	177	1,384.5	0.87	14.2	Do.
81	177	8,747.0	5.51	25.8	Do.
82	177	4,792.0	3.02	27.4	Trunk attacked by white ants.
83	177	1,987.0	1.25	16.2	Do.
84	177	3,241.2	2.04	24.6	Healthy.
85	160	6,142.0	3.87	31.2	Do.
86	153	5,949.0	3.75	24.2	Do.
87	127	1,105.6	0.70	26.4	Do.
88	127	2,517.0	1.59	24.5	Hacked trunk.
Total	14,640	491,240.3	309.21	2,284.7	
Average	166.3	5,582.3	3.51	25.96	

During the tapping period of April 12 to May 11, 1926, trees Nos. 5, 15, 17, 19, 20, 23, 26, 56, 73, 82, and 87 failed to produce for a day; Nos. 11, 65, 67, 74, and 81 for two days; and Nos. 79, 83, and 80 for three, four and six days, respectively. Trees Nos. 68–88 only were opened for tapping on April 12th and tapping of these trees was commenced the following day. Tree No. 76 was tapped for eight days only and did not produce latex on the first day, because of the weak condition of the trees resulting from burning its trunk.

On June 15 to July 14, 1926, trees Nos. 4, 5, 9, 11, 14, 22, 58, 60, 62, 63, 64, 66, 71, 75, 77, 78, 80, 82, 83, and 88 gave no latex for a day; Nos. 16, 65, and 70 for two days; No. 72 for three days; No. 74 for four days; Nos. 25 and 67 for six days; and No. 69 for ten days. During the period tree No. 76 died and only 87 trees were tapped thereafter. No. 66 was rested for nine days at the beginning of this tapping period because of its weak condition due to fire too, and also No. 68 was given a rest for 26 days.

On August 15 to September 14, 1926, trees Nos. 11, 25, 56, 65, 74, 78, 80, and 83 produced no latex for one day; and Nos. 87 and 69 for three and four days, respectively. Rain interfered with the tapping of all the trees for 14 days and the collection of latex of trees Nos. 1–18 and 49–88 on September 8,

1926. Another five trees succumbed during the period, as a result of the fire viz., trees Nos. 66, 68, 70, 71, and 72, which making a total of six dead trees including No. 76 of the previous month so that the total number of trees tapped amounted to 82 trees only.

On October 16 to November 15, 1926, because of the shortage of collecting cups to replace the missing ones trees Nos. 1, 86, 87, and 88 were not tapped on November 8–15, inclusive; No. 43 on November 4–7; and No. 45 on November 4–15.

During the tapping period of December 15, 1926 to January 15, 1927 only 80 trees were tapped because there were no collecting cups for two or the trees (Nos. 87 and 88), and also Nos. 80, 81, 82, 83, 84, 85, and 86 were not tapped on December 15th for the same reason. Trees Nos. 4, 5, 11, 52, 56, and 67 failed to yield for one day during the period; Nos. 74 and 84 for two days; and Nos. 69 and 14 for 11 and 15 days, respectively.

On February 16 to March 15, 1927, trees Nos. 67 and 69 were rested because of their weak conditions, and Nos. 85–88 were not tapped from February 15th to March 4th because of the shortage of collecting cups. Trees Nos. 4, 10, 13, 15, 25, 45, 56, 63, 64, 78, 82, 83, 85, and 88 gave no yield for a day; Nos. 37, 54, 57, 80, and 84 for two days; Nos. 29, 86, and 87 for three days; No. 52 for five days; No. 11 for six days; No. 65 for seven days; No. 42 for eight days; Nos. 2, 25, and 43 for nine days; No. 58 for ten days, Nos. 14 and 73 for thirteen days; and No. 51 for fourteen days.

April 15 to May 15, 1927, tree No. 73 was rested for the whole period because of its poor appearance. Trees Nos. 2, 5, 6, 10, 15, 18, 25, 61, 64, 77, 85, and 86 produced no latex for a day's tapping; Nos. 7, 13, 26, 52, and 79 for two days; Nos. 11, 14, 27, 29, 48, 56, and 69 for three days; Nos. 54, 58 and 80 for four days; Nos. 65 for five days; Nos. 57 and 83 for seven days; No. 4 for nine days; Nos. 51 and 82 for eleven days; No. 43 for twelve days; No. 46 for fifteen days; and Nos. 42, 74, and 78 for eighteen days.

The ten best yielding trees are trees Nos. 16, 32, 19, 44, 42, 3, 24, 59, 47, and 30. They gave yields of 12.21, 10.70, 9.64, 9.54, 8.92, 8.66, 8.50, 8.27, 8.17 and 7.19 pounds of dry rubber respectively.

Taking 182 as the number of the tapping days in a year for alternate days or months, which is the common rule in the rubber growing countries, and 100 trees to the acre at the final thinning of a rubber plantation; the calculated yields per acre of these

trees would be as follows: 1,248.52 pounds for No. 16; 1,086.54 pounds for No. 32; 979.16 pounds for Nos. 19 and 44; 906.36 pounds for No. 42; 884.52 pounds for No. 3; 862.68 pounds for No. 24; 844.48 pounds for No. 59; 829.92 pounds for No. 47; and 729.82 pounds for No. 30. (1 kilo—2.2046 pounds and 1 hectare 2.471 acres).

DESCRIPTIVE LIST WITH CULTURAL DIRECTIONS OF GABI, *COLOCASIA ESCULENTA*, VARIETIES GROWN AT THE LAMAO EXPERIMENT STATION, LAMAO, BATAAN [1]

1. *Gabi No. 4.*—Plant lax—leaves erect, 5 to 7 feet high, peltate, leafstalks spreading from base; blades usually obliquely nodding from the stalks, ovate; green above and whitish green beneath; petiole whitish green with tip slightly shaded with half-ringed purple color; corm oblong, bud white to creamy white, flesh white, 1 to 3 corms per hill. Cooked corm: meat grayish white, mealy chestnut flavor but stringy in some. Tuber 1 to 4 per whorl of leaves, shape from ovate to elongated. Cooked: finer grained with less fiber than the corm, flesh grayish white, chestnut flavor. The yield is about 7,842 kilos per hectare; period of maturity about 255 days.

2. *Katibe.*—Plant somewhat compact—leafstalks somewhat erect, blade broadly ovate, rather dark velvety green above and light green beneath; peltate; veins and veinlets dark green on upper surface, maroon shaded on lower surface; petiole dark green, maroon shaded; 2 to 4 plants per hill, very susceptible to leaf blight; corm spherical, buds purple, flesh violet outside and slightly violet inside, 1 to 4 corms per hill. Cooked: no change in color, mealy, good flavor. Tuber: 2 to 8 per whorl of leaves, generally oblong. Cooked tuber: violet outside and grayish violet inside, mealy. The yield is about 20,242 kilos per hectare; period of maturity about 248 days.

3. *Yautia.*—Plant compact—leaves erect; blade broadly ovate, rather dark velvety green above and whitish green beneath, wrinkled with the characteristic distinct continuous line bordering along the entire margin, base sagittate, 1 to 2 corms per hill, 2 to 9 tubers per corm, resistant to leaf blight; corm generally oblong, flesh white, buds reddish. Cooked: white to grayish white, mealy. Tuber generally ovoid, and when cooked is mealy, rather dry and chestnut flavor. The yield is about 8,540 kilos per hectare; period of maturity about 257 days.

4. *Palawan.*—Plan compact—leaves erect, blade broadly ovate, rather dark velvety green above and light green beneath, pel-

[1] Circular No. 216.

tate; veins and veinlets dark green on upper surface and maroon shaded beneath; 2 to 8 corms per hill; corm spherical, flesh creamy white. Cooked: flesh violet color, mealy, rather dry and with a chestnut flavor. Tuber: 5 to 8 per whorl of leaves, ovoid to oblong in shape, flesh white. Cooked: flesh lighter violet color and finer grained than the corms, less flavory. Rather susceptible to leaf blight. The yield is about 5,086 kilos per hectare; period of maturity about 248 days.

5. *San Fernando*.—Plant compact—leaves erect; blade broadly ovate, rather dark velvety green above and whitish green beneath, wrinkled with the characteristic distinct continuous line or veins on both surfaces running along the entire margin; base sagittate; 1 to 3 corms per hill; corm oblong with the cream colored buds, flesh white to light cream color. Cooked: grayish white, mealy with chestnut flavor. Tuber: 4 to 23 per hill, ovoid. Cooked: gray with finer grain and moister than the corm, mealy. Resistant to leaf blight. The yield varies from 7,000 to 17,000 kilos per hectare; period of maturity about 260 days.

6. *Tanay*.—Plant lax—leaves erect, peltate, leafstalks spreading from base, blades ovate; whitish green beneath; petiole whitish green with a half-ringed purple color at the tip; corm elongated, buds white to creamy white, flesh white. Cooked: flesh grayish, mealy, chestnut flavor. Two to seven lateral tubers arise from a single corm. Tuber generally ovate, softer and finer grained than the corm, flesh gray and mealy. The yield is from 7,500 to 16,000 kilos per hectare; period of maturity about 255 days.

7. *7484 Sangao*.—Plant somewhat compact—leaves not erect, blade broadly ovate, rather dark velvety green above and green beneath, peltate; veins and veinlet dark green on upper surface shaded with maroon on the undersurface; petiole dark green and maroon shaded especially on the lower surface; somewhat susceptible to leaf blight. Corms elongated; tubers long to ovoid; buds white and creamy white in some; flesh white. Each hill produces from 1 to 4 corms and 5 to 14 tubers per plant. Matured corms when cooked is tough, sticky, chestnut flavored and is grayish white. Cooked tubers are somewhat mealy, lighter in color and finer grained than the corms, though often less rich in flavor. The computed yield per hectare varies from 10,000 to 15,000 kilos; period of maturity about 255 days.

8. *"Black."*—Plant somewhat compact—leaf stalks more or less erect; blades nearly at right angles with leaf stalks which are usually dark green and maroon shaded; veins and veinlets

dark green on upper surface, maroon shaded on lower surface; 2 to 4 plants per hill; very susceptible to leaf blight; corm spherical, buds purple, flesh violet outside and light violet inside, 1 to 4 corms per hill. Cooked: flesh violet outside and light violet inside, somewhat mealy and of a chestnut flavor; tuber generally spherical; when cooked is rather mealy and of a chestnut flavor. The grain is much finer than the corm. From 14 to 37 tubers are produced per hill. The computed yield per hectare is about 8,000 kilos; period of maturity about 248 days.

CULTURAL DIRECTIONS

Planting season.—Gabi and yautia are generally planted at the beginning of the rainy season. In some parts of the Islands where irrigation water is available, they are planted about a month before the rainy season begins.

Preparation of the ground.—A moist but fairly well drained rich sandy loam soil is best suited for the best development of yautia and gabi. The ground should be thoroughly prepared. It sould be plowed and harrowed alternately in lengthwise and crosswise directions for three times or so.

Planting.—Like sweet potato and many other root crops, gabi and yautia are grown better in ridges 1 meter apart. Plant the tubers 0.7 meter apart in the ridges. The depth of planting should be from 3 to 4 inches.

Cultivation.—The length of time that elapses between planting the tubers and the appearance of the shoots depends to a great extent upon the condition of the tubers and also to climatic and soil conditions. Under normal conditions, the tubers sprout after 2 weeks. Thorough cultivation should be done in the early stage of the plants for cultivation by plowing when the plants are maturing would likely damage the roots and other parts of the plants. Cultivate by plowing from time to time while young so as to cover the bases of the plants. Periodical weeding should be attended to and the soil slightly stirred during dry weather to prevent excessive evaporation of moisture.

Harvesting.—The maturity of the crop is indicated by the drying of the leaves and general cessation of growth of the plants. The crop takes from 10 to 11 months to mature. In small plantations, harvesting with the use of spading fork or mattock will not be too costly. In big plantations it is advisable to use plow for turning the plants over. After digging the plants, grass the shoots and thoroughly shake the whole plant to dislodge as much of the soil as possible that adhere to the

tubers. Then cut the shoots with a bolo or knife. Put the corms and tubers in sacks.

Cleaning.—The entire cleaning of the corms and tubers may be entirely done in the field. The bases of the leafstalks should be entirely removed from corms and tubers that have borne leaves. All the feeding roots and other loose fiber should also be removed.

Selection.—Before disposing off the crop in the market, the seeds for another crop should be first selected. Select tubers of ovoid or spherical shape and weight from 60 to 120 grams. Dry the seeds in the sun before storing.

Storage.—There are several ways of storing gabi seeds. But the most common method is to dig a pit or trench sufficiently big under the house to accommodate all the seeds. The seeds are then put into this pit and are covered with soil. Where a large quantity is to be stored, a small shed may be constructed near the house. Inside this shed the pit should be dug. The seeds are then stored in the same way as the method described above.

VARIETAL DESCRIPTION OF UBI, *DIOSCOREA ELATA*, AT THE LAMAO EXPERIMENT STATION, LAMAO, BATAAN *

By JUAN M. EJERCITO
Agricultural Assistant

(1) *Basol.*—Leaf generally round in old and acute in young, drawn towards together, opposite, veins and midrib whitish green on both surfaces, mature average large leaf 15.2 centimeters long and 14 centimeters across, petiole whitish green but pink at the base and tip; stem four-angled, 6 to 7 millimeters in diameter, whitish green with purplish edges, tuber long and protruding into the ground, unbranched, from straight to upcurving, not perfectly round in diameter, rooty all over but more especially on the surface; roots robust; skin dark brown, 1 to 1.5 millimeters thick, rough; flesh granular white turning brown quickly when exposed to air, sap abundant, fiber not visible. Cooked tuber: no change of color, mealy. Approximate yield per hectare, 21,900 kilos and period of maturity 234 days.

(2) *Binanog.*—Leaf generally round in old and acute in young, drawn towards together, opposite, dark green, midrib and veins whitish green on both surfaces, mature average large leaf 15 centimeters long and 12 centimeters across; young leaves slightly pinkish; stem four-angled, green with edges purplish, 5 millimeters average diameter; rooty on the surface, roots robusts; tubers of various shapes and sizes, from round to flattened and branched in others; skin brown, smooth, about 1 millimeter thick; flesh white, granular; sap abundant. Cooked tuber: no change of color, mealy. Approximate yield per hectare, 11,750 kilos; period of maturity 234 days.

(3) *Binato.*—Leaf acute, drawn towards together, opposite, veins and midrib whitish green on both surfaces mature average large leaf 16 centimeters long and 10 centimeters across, base and tip of petiole whitish green; young leaf yellowish green; stem four-angled, green with edges slightly pinkish, 4 to 5 mil-

* Circular No. 217

limeters in diameter; roots moderate, mostly on the surface; tubers of various shapes and sizes, roundish, flattened or forked in others, skin smooth, grayish black, rough, cortex layer creamy white and turns brown upon exposure to air, granular; sap abundant, fiber not visible. Cooked tuber: no change in color, mealy. Approximate yield per hectare, 11,059 kilos; and period of maturity 230 days.

(4) *Cebu.*—Leaf acute, drawn towards together, opposite, veins and midrib whitish green on upper surface and pinkish purple beneath, petiole distinctly purple at the base and tip; young leaf pinkish purple, mature average large leaf 18 centimeters long and 12 centimeters across; common origin of midrib and veins on upper surface is purple spot-like; stem four-angled, green, with edges purple, 5 to 6 millimeters in diameter; roots moderately robust, scattered around the tuber; tubers of various shapes and sizes, from round to flattened and branched in others, skin grayish black, cortex layer deep violet, flesh proper violet and somewhat granular. Cooked tuber: no change in color, mealy and odorous. Approximate yield per hectare, 27,725 kilos; period of maturity, 230 days.

(5) *Hinaligue Morado.*—Leaf generally acute, drawn towards together, opposite, midrib and veins whitish green on both surfaces, base and tip of petiole purplish, mature average large leaf 18 centimeters long and 11.6 centimeters across young leaves yellowish green, stem four-angled, whitish green, with edges slightly pinkish, 5 to 6 millimeters in diameter; tubers long, protruding into the ground, not branched, diameter not perfectly round, roots large and mostly on the surface, skin about 1 millimeter thick, grayish brown, flesh proper yellowish pink, granular, cortex layer cream colored. Cooked tuber: no change in color, mealy. Approximate yield per hectare, 25,358 kilos; period of maturity, 235 days.

(6) *Hinaligue White.*—Leaf generally round, drawn towards together, opposite, midrib, and veins whitish green on both surfaces, base and tip of petiole slightly pinkish, mature average large leaf broad, measuring 23 centimeters long and 16 centimeters across; young leaves slightly pinkish; stem four-angled, green, with edges slightly purple, 6 to 7 millimeters in diameter; tubers long, ranging from 30 to 50 centimeters, diameter not perfectly round being about 20 centimeters; shape varies from straight to upcurving, rooty all over; roots large and robust, mostly on the surface, skin dark brown, about 2 millimeters thick, flesh granular; white to light cream color, sap magenta

and abundant. Cooked tuber: no change of color, somewhat mealy. Approximate yield per hectare, 11,443 kilos; period of maturity, 235 days.

(7) *Kinalabaw.*—Leaf generally roun but acute in some, drawn towards together, opposite, veins and midrib whitish green, base and tip of petiole pinkish, mature average large leaf 16.5 centimeters long and 12 centimeters across; young leaf slightly pinkish purple; stem four-angled, green, with edges slightly purple, 6 to 7 millimeters in diameter, tuber protruding into the ground, long, measuring from 40 to 60 centimeters, rooty on the surface, roots robust; skin dark brown, rough, cortex layer whitish yellow, flesh proper pinkish yellow turning yellowish brown upon exposture to air, granular. Cooked tuber: no change in color, mealy. Approximate yield per hectare, 31,231 kilos; period of maturity, 235 days.

(8) *L. E. S. No. 1.*—Leaf round with cordate base that generally overlaps each other, drawn towards together, opposite, veins and midrib whitish green on both surface, base and tip of petiole pinkish; mature average, large leaf 18 centimeters long and 12.5 centimeters across; young leaves slightly pinkish; stem four-angled, green, with edges purple, 5 to 6 millimeters in diameter not perfectly round, being from 20 to 25 centimeters, roots large and robust; skin black to dark brown, about 1 millimeter thick, rough; cortex layer creamy color, flesh proper yellow to pinkish yellow turning brown upon exposure to air, granular. Cooked tuber: no change in color, mealy. Approximate yield per hectare, 22,498 kilos; period of maturity 235 days.

(9) *Minanog.*—Leaf round, drawn towards together, opposite, light green, veins and midrib whitish green on both surfaces, petiole whitish green; mature average large leaves 16 centimeters long and 11 centimeters across; yellowish green; stem four-angled, green, 5 to 6 millimeters in diameter; tuber of various shapes and sizes, skin grayish black, smooth, flesh white, sap abundant. Cooked tuber: no change in color, somewhat sticky. Approximate yield per hectare, 16,301 kilos; period of maturity, 230 days.

(10) *Sampananon.*—Leaf acute, drawn towards together, opposite, midrib and veins whitish green on both surfaces with their common origin on upper surface appearing as a purple spot-like, base and tip of petiole pinkish purple; average mature large leaf greenish yellow; stem four-angled with edges slightly, pink, about 4 millimeters thick, flesh light pink, granular; roots

sparsely scattered around the tuber but mostly on the surface. Cooked tuber: light brown, mealy. Approximate yield per hectare, 11,490 kilos; period of maturity, 234 days.

(11) *Sinawa.*—Leaf round, drawn towards together, opposite, veins and midrib whitish green; mature average large leaf 15 centimeters long and 12 centimeters across, petiole pinkish purple at base and tip; young leaves pale green; stem four-angled, whitish green, with edges purple, about 6 millimeters in diameter; tuber long contorted and snake-like, extrading from the ground, rooty on the surface, skin dark brown, 1 millimeter thick, cortex layer pinkish purple, flesh proper yellowish brown, turning brown upon exposure to air, granular, sap abundant. Cooked tuber: no change in color, somewhat sticky. Approximate yield per hectare, 21,344 kilos; period of maturity, 230 days.

(12) *L. E. S. No. 2.*—Leaf round, drawn towards together, oposite, veins and midrib whitish green on both surfaces, base and tip of petiole purplish, average mature leaf 20 centimeters long and 13 centimeters across; young leaf pinkish; stem four-angled, green, with edges pinkish; 5 to 6 millimeters in diameter; tuber long and of various shapes and sizes, varying from straight to up curving, diameter not perfectly round; skin dark brown, about 1 millimeter thick, rough; roots sparsely scattered, flesh creamy white, granular. Cooked tuber: no change in color, mealy. Approximate yield per hectare, 23,145 kilos; period of maturity, 235 days.

SOME IMPORTANT DISCOVERIES ABOUT MIGRATORY LOCUSTS IN OTHER COUNTRIES AND THEIR APPLICATION IN THE PHILIPPINES [1]

By F. Q. OTANES

Entomologist

Of late signal discoveries have been made about certain migratory locusts in other countries that should be of interest here, especially to those of us who are actually engaged in the study and control of the migratory locust, *Pachytylus migratorioides*.

A few years ago Russian entomologists engaged in the study and control of the migratory locust (*Locusta migratoria*) in Southern Europe, in the region of the Caspian Sea, noted that swarms of hoppers consisted of two distinct forms, which had previously been regarded as immature stages of two distinct species, *Locusta danica* and *Locusta migratoria*. One of those entomologists, V. Plotnikov, found from rather extended breeding experiments that by "suitably altering the conditions of breeding one can be turned into the other."

Utilizing the data obtained by Plotnikov, B. P. Uvarov, another Russian entomologist, formed the so-called "phase theory" according to which these two forms are merely "phases" or "physiological forms of one insect, the one solitary and sedentary and the other gregarious and migratory." In other words, *Locusta danica* is, according to these observations, not a different species, as it was always hitherto regarded by systematists, but a form or a phase of *Locusta migratoria*.

According to Uvarov, our local migratory locust, *Pachytheylus migratorioides* is also a form or phase of *Locusta migratoria* and he cites certain facts, which I have given elsewhere to support his contention.

Commenting on the morphological characters of both *migratoria* and *danica*, Uvarov states that these two forms (and we may include *migratorioides* also), if typical specimens are studied, seem to be quite distinct from each other, and may

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[1] Paper read before the Philippine Society of Technical Agriculturists, September 25, 1927

be regarded, as has been done by most authors, as two independent species. On the other hand, he says that extensive collections include specimens of *Locusta* that cannot be identified with either *migratoria* or *danica* but seem to represent intermediate forms. This fact, he adds, has induced many authors to regard *migratoria* and *danica* as but extreme individual aberrations of the same species. He gives the following summary from his study of numerous specimens:

L. migratoria	*L. danica*
Vertex convex, with a median longitudinal keel; fastigium separated from frontal ridge by an angular transverse keel.	Vertex flat, without median keel; no transverse keel separating fastigium from frontal ridge.
Pronotum relatively shorter and broader in metazona, with a distinct constriction before the middle; fore margin rounded; hind angle rounded; median keel low, in profile straight or even concave.	*Pronotum* relatively longer and more compressed laterally without or with but feeble constriction before the middle; fore margin angulately prominent; hind angle acute; median keel high, tectiform convex in profile.
Elytra relatively longer. *Hind femora* relatively shorter.	*Elytra* relatively shorter. *Hind femora* relatively longer.

He went to the extent of measuring certain parts, the length of the pronotum and width of the shoulder and the length of hind femur and elytron or forewing, of numerous specimens and ascertained the relative proportions of these parts, but he concludes that the data obtained seemed to be rather contradictory, or anyway, do not help much towards a definite solution of the question, whether these two forms are really distinct or not. He finds, however, that there are no marked differences between the genitalia of the two forms.

As to *migratorioides* he states that the morphological features of it are very much like *migratoria,* while the differences from *danica* are far more marked. Among the differences of *migratorioides* from *migratoria* are these: "The pronotum is still more constricted before the middle; its median keel very low, often concave and profile; fore margin almost straight; hind margin very widely rounded; the shoulder width equal to the length of the pronotum." And as to the genitalia of male specimens of *migratorioides* he examined he finds no difference whatever, to use his own words, from the structure observed in *danica* and *migratoria.*

In this and in the coloration of larvae or nymphs as given by H. C. Pratt in the Malay Peninsula and from specimens sent him by Pratt from that region, Uvarov finds an indication that

the same interrelation exists between *migratorioides* and *danica*, as has been proved positively for *migratoria* and *danica*. He goes on to confirm this by speaking of the specimens of locusts sent from North Borneo to the Imperial Bureau of Entomology, London, for identification. He says that they all proved to be *migratorioides*, but as the lot was rather small the Bureau asked for more material and after several months a new collection arrived with a note that the specimens had been taken singly from the same place where the swarms from which the first lot had been collected, and represented the actual offspring of those swarms. All specimens in this second lot were quite typical *danica*. He says, too, the same thing occurred in Africa, where specimens of *danica* were collected several months after the occurrence of a swarm of *migratorioides* on the same spot. "All these facts," he says, "of course do not furnish us with absolute proof of the transformation of *migratorioides* into *danica*, but since such a transformation is established for *migratoria* and *danica*, I feel justified in assuming it to be true in this case also."

GEOGRAPHICAL DISTRIBUTION OF THE THREE FORMS OR PHASES

L. danica, according to Uvarov, has the most extensive distribution, being found throughout the whole Eastern hemisphere, except in the coldest regions beyond 60° north and south latitudes, very high mountains, and vast waterless deserts. It does not exist in the Western hemisphere and he says records of its existence there are due to mistakes, either in labeling the specimens or to misidentification.

Since *L. danica* has such a wide distribution, it is not strange, he says, that it presents geographical variations. Thus, he cites as examples, Australian and New Zealand specimens, which are rather small on the average with a comparatively short pronotum and the wings slightly infumate and have been described as a distinct species, *Pachytylus australis* [2] Sauss. Whether such characters are constant or not in those regions can only be ascertained by further study.

P. migratorioides is not as widely distributed as *danica* as it does not occur in the Palaertic region.

[2] Listed by Prof. L. Bruner of the University of Nebraska in his preliminary catalogue of Orthopteroid Insects in the Philippines, 1915. Specimens are found in the Bureau of Science collection.

As to *L. migratoria* its home according to Uvarov is the region mentioned (Palaeartic) especially the basins of the Black, Caspian, and Aral Seas, and that of Lake Balkash, where its permanent breeding grounds are found. Emigrating swarms, however, reach much farther north and east, sometimes as fas as Finland and England. Specimens have also been taken from the Malay Archipelago (Batam and Borneo) and also from Southern Celebes showing that it is also widely distributed.

BREEDING GROUNDS OF P. MIGRATORIOIDES

Uvarov discusses at some length *P. migratorioides* and inasmuch as this is our local migratory form it is worth while to give his views here. He regards *migratorioides* as the oldest form of the species, "since its morphological and color characters are far more constant in comparison to the more plastic *migratoria,* to say nothing of the extremely variable *danica.*"

In a paper presented three years ago before this Society, I discussed the subject of natural enemies and breeding grounds in connection with *P. migratorioides,* our migratory locust. Of breeding grounds I said

"So far our information on this matter of the permanent breeding grounds is in the nature of generalities. There is also divergence of opinion on this matter. Some said that the breeding grounds are found in Mindanao; others have a different opinion. Mr. D. B. Mackie, formerly entomologist of the Bureau of Agriculture, for example, has been quoted officially as having arrived at the conclusion that the permanent breeding grounds of the locusts are found in the following sections:

1. The central plateau in the island of Bohol.
2. The vicinity of Tankulan in Bukidnon.
3. The country back of Fort Pikit in Cotabato.
4. The Batiggui and Guimatal country along the boundary line of Cagayan, Isabela, and the Mountain Province.

What is meant by permanent breeding grounds? Does it mean regions where locusts are found in more or less number at all times of the year and from which come swarms that infest community areas? Or does it mean all extensive isolated stretches of grass lands, where locusts are not nocessarily found all the year around but where swarms may breed and multiply before they migrate to community areas?"

I also pointed out some of the most important problems that need to be studied in the breeding grounds, such as the factors that influence and cause migration.

Of the permanent breeding grounds of *P. migratorioides* Uvarov says in full:

"The permanent breeding regions of *migratorioides* have never yet been investigated. The only description of breeding places of this form in the Malay States given by H. C. Pratt must obviously be referred not to the permanent breeding grounds, but merely to the places where the oviposition of emigrated swarms took place. All we know at present concerning the permanent breeding areas of *migratorioides* is based on the records of the occurrence of its swarms; and these data enable us to state that the best conditions for the development of this form seem to be present in tropical countries with a rather damp and hot climate, but undoubtedly not in forest. Since, on the other hand, these breeding grounds seemed to be undiscovered we may presume that they are also not in open grassy land, which is easily accessible and mostly cultivated or anyhow populated. I believe, therefore, that permanent breeding grounds of *migratorioides* are to be looked for somewhere in the impenetrable jungles overgrown with high grasses, reeds, and such like vegetation; but even if I am mistaken in this supposition, it would not affect my theory which is based on the indubitable fact that the permanent breeding of *migratorioides* is possible only in localities with certain natural conditions, whatever those conditions may actually be.

Another well known fact is, that the development of *migratorioides* in its breeding grounds does not go on always at the same rate but that it is subject to a periodical rise and fall though the exact cause of the increase of locusts is entirely unknown. When the increase is at its height, large swarms are formed, and their emigration follows. Such emigrated swarms settle down and oviposit whenever they are compelled to do so by purely physiological causes, and their progeny undergoes a transformation into the solitary-living phase—*danica.* The very plastic, easily adaptable, and in all respects more progressive *danica* must play an important part in the extension of the range of the species, gradually but steadily populating new regions. Being a product of a mutation arising partly from some unknown internal cause and partly from outer (probably climatic) influences, *danica* is naturally subject to sudden displays of atavism, which results in the transformation into the ancestral phase *migratorioides.* We do not know yet whether this phenomenon can occur spontaneously as a result of some internal physiological factor, but there is no doubt that it is much favoured and often probably caused by the oviposition of *danica* taking place under conditions like those of the permanent breeding grounds of *migratorioides.* The gregariousness of the *migratorioides* phase, is of course, one of the causes of a rapid increase in the number of individuals and swarms, and soon—in the course of a few generations—the size of the swarms reaches the maximal point, which is followed by emigration. In this way the dispersion of the species goes on alternately by the gradual spreading of the *danica* phase and by the periodical extensive emigrations of *migratorioides.* As a result, the species is now distributed all over the Eastern hemisphere; but, as we know, the distribution of *migratorioides* is limited to tropical regions only, while *danica* goes over to the Palaearctic region as well, where the swarming phase of the species is represented by *migratoria.* This latter fact might be satisfactorily explained by the impossibility of finding in the Palaearctic region the natural conditions exactly like those of the tropical breeding grounds of *migratorioides,* chiefly

in regard to a combination of heat and dampness. The above-described reed-beds of *Phragmites* in the southeastern part of the Palaearctic region represent in all respects the nearest possible approach to tropical conditions. This statement is strongly supported by the fact that the fauna of these reed-beds includes two more *Acridians* of an undoubtedly tropical origin; these are *Gelastorrhinus sagitta*, Uvar., and *Oxya turanica*, Uvar., both described from the valley of the Amu-Darya, in Transcaspia, and the former found also on the River Kura, in Transcaucasia. Though very peculiar, and in the summer recalling the tropics, the climatic conditions of these reed-beds are, of course, not tropical and their effect on the progeny of *danica* breeding there is not the same as in the tropical breeding grounds of *migratorioides*: the reverse transformation of *danica* into a swarming phase does not reach the phase of *migratorioides*, but stops half-way at the *migratoria*-phase. This seems to indicate that the transformation is due primarily to the direct influence of external conditions, its extent being proportional to changes in the latter, but only precise laboratory investigations can help to clear up this complicated problem. It is interesting to recall here that individuals of *migratoria* incidentally occur in tropical countries also and we may presume that their appearance is due to some abnormal conditions of the development.

Little is known yet as to what happens in the breeding grounds after the emigration, except that the number of locusts drops, suddenly to a minimum. I presume that scattered swarms of the gregarious phase, as well as the progeny of individuals of the solitary phase, cause the gradual increase in the number of swarming individuals, and after a few years a new emigration occurs.

Thus, the periodicity of locust invasions is caused entirely by the wonderful phenomenon of the transformation of a swarming locust into a solitary, harmless grasshopper. Of course, the outline here sketched is necessarily rough, and the actual proceedings are far more complicated, but the theory seems to me to be the best possible in the circumstances.

The biological result of these phenomena is that the maintenance and dispersion of the species is insured in all circumstances: the swarming phases enable the species to extend at one stroke its area of distribution to distant regions, and its dispersion to the remotest island is undoubtedly due to emigrating swarms; on the other hand, the well protected and easily adaptable solitary phase secure a strong footing in the countries thus reached, and under favourable conditions gives rise to new emigrants; the results achieved show that such an arrangement has been extremely useful to the species. Even the most radical changes in the natural conditions of the permanent breeding regions would result not in the extermination of the species, but only in its transformation into the more adaptable *danica* phase.

An example of that kind occurred in Southern Russia. Though the now existing permanent breeding regions are restricted as I have described above to the valleys of the rivers discharging into the Caspian and Aral Seas and Lake Balkash, the Deltas of rivers emptying into the Black Sea (i. e., Kuban, Don, Dnieper, Danube, and etc.) also harboured not very long

ago—up to the end of the eighties of the last century—some permanent breeding grounds of *migratoria*. At present, however, only the lower valley of the Danube is still a breeding region, while the valleys of the other rivers of the basin of the Black Sea no longer serve that purpose. This is easily explained by the fact that the valleys of Don, Kuban and Dnieper were during the end of the last century more or less cultivated or, at any rate, their natural conditions were entirely changed by the persistent grazing of herds of cattle. As a direct result of this the possibility of the transformation of the solitary phase into the swarming one exists there no longer, and though the transformation takes place incidentally, single specimens of *migratoria* being not uncommon, their numbers do not increase, nor are swarms ever found.

The theory of phases suggests the theoretical possibility of the control of *migratoria* by some measures directed not against the insect itself, but against certain natural conditions eisting in the breeding regions which are the direct cause of the development of the swarming phase. The above-quoted example in South Russia shows that even comparatively slight cultivation of breeding regions leads to the desired changes; but the conditions necessary for the breeding of the swarming phase have not been exactly studied, nor are the direction and extent of such changes known. The first step, therefore, should be the most careful investigation of all existing, as well as extinct, breeding regions, together with parallel breeding experiments under laboratory conditions; on the basis of results thus gained a system of theoretically useful and practically possible measures for the conversion of breeding regions may be outlined.

INVESTIGATIONS IN COUNTRIES OTHER THAN RUSSIA

Almost at the same time as the Russian entomologists an entomologist in South Africa, J. C. Faure, found out from field and laboratory investigations that the South African locust, *Locusta pardalina,* also has two forms or two phases, a gregarious or swarming phase and a solitary phase, specimens of the latter being found within the borders of South Africa and that large outbreaks may also arise within South Africa and not chiefly from the Kalahari Desert, which was formerly the belief.

Lately, an entomologist in the Sudan, H. Bennett Johnston, has also found that the migratory locust there *Schistocerca gregaria* has also a solitary phase, *S. flaviventris,* which "differs completely both in external appearance of the immature stages and in habits of life from the other, the swarming the migratory form. Notwithstanding these differences the former can on occasion transform itself into the latter. This it does by means of a gradual change through a succession of two or more broods till it arrives at the pure migratory form. The solitary locust

which occurs throughout the country (Sudan) is thus a reserve force from which may be produced large swarms of the migratory locust. Moreover, it is now known that this process can be reversed by the adoption of suitable control measures and the attempts to produce the migratory forms rendered abortive."

Johnston explains the practical importance of these facts as follows, and his explanation may apply as well to other migratory locust elsewhere:

> The practical significance of these facts is obvious; namely, that by keeping and curtailing its early breeding activities the more dangerous swarming phase may be prevented from appearing at all.

OUR PROBLEMS

As I have pointed out there is yet a lack of exact knowledge regarding the breeding grounds of the migratory locust (*P. migratorioides*) in the Philippines to be accounted for by the extensiveness of the isolated stretches of grass lands here and the fact that no provisions were ever made until lately for a systematic study of this subject here. It has only been for about three years that the Bureau of Agriculture has been provided with money to carry on scouting work in the isolated areas for the purpose not only of destroying the locusts there but also to locate the areas where swarms originate. If this work is continued, it is hoped that much definite knowledge of the breeding grounds and of the habits and behaviour of the locusts there will be obtained.

With the knowledge that migratory locusts have a gregarious or swarming phase and a non-gregarious or solitary phase, we should know in connection with our scouting work, best under the technical guidance of a Locust Commission, find out or rather verify by extensive observations whether or not the migratory form here, *P. migratorioides* has a solitary phase, *L. danica*,[3] here and if it has we should also study the distribution and breeding habits of this form and take the necessary steps to at least minimize its developing into the swarming phase (*P. migratorioides*) if this really happens here. When that is done we shall have gone a long way toward permanently controlling the migratory locust in the Philippines.

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[3] *L. danica* is listed by L. Bruner in his Preliminary Catalogue of Orthopteroid Insects in the Philippines, 1915, from specimens in Los Baños and Manila.

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NOTES—FOURTH QUARTER

TROPICAL FOODS AND THEIR PRESERVATION

Whenever the Caucasian goes to the tropics as a rule he lives largely on canned goods shipped from home if they are obtainable rather than make a serious attempt to acquaint himself with the many novel foods in his new surroundings. He forgets that sensible old saw, "When in Rome do as the Romans." In view of what we have learned of late about vitamines, who knows but that to this fact may be attributed at least in part the wasting away at comparatively early age of many who otherwise might have reached a ripe old age? Again, with the notable exception of the pineapple, canning and preserving fruits have been all but unknown in the tropics, to say nothing of vegetables, and whereas in temperate countries house wives are busy preserving and canning during summer and fall for the coming winter, in the tropics untold quantities of fruits annually go to waste. Of course in part the perpetual summer is responsible for this situation.

During the past two years three small, but really notable publications have appeared that aim to remedy both these conditions, and stimulate the use of locally grown tropical vegetables and the preservation of foods; one, *The Preservation of Philippine Foods,* by Maria Y. Orosa, published by the Bureau of Science, Manila, P. I., and the others tropical foods, *Bulletin No. 1, Chayote, Yautia, Plantain, and Banana;* and *Bulletin No. 2, Arracacha, Breadfruit, Cassava, Leren and Malanga,* by Professor Elsie Mae Willsey, University of Porto Rico. The price of the two latter bulletins is $0.50 each.

In *The Preservation of Philippine Foods* the principal methods used in preserving foods, such as drying, salting, pickling and sterilization, are first considered, followed by a more detailed discussion of canning practices, and directions for canning a large number of Philippine fruits, all of which except two, by the way, are also found in various other countries. Detailed instructions for making jelly, marmalade, fruit butters, pastes, and preserves also are given. The bulletin is concluded by instructions for canning vegetables and making pickles and chut-

neys. Textfigures illustrating canning outfits and utensils, and methods of procedure would have added materially to the value of a first publication of this kind in a country where canning methods are practically unknown.

Tropical foods, *Bulletin No. 1*, contains 18 recipes for preparing the Chayote, 13 for the Yautia, and 26 different ways of serving bananas and plantains. *Bulletin No. 2*, gives 14 recipes for serving the Arracacha, a popular vegetable in Porto Rico and other tropical American countries, still unknown in the Philippines. Lovers of the seedless breadfruit will be both astonished and delighted to find 17 ways of preparing it for the table. There are four recipes for serving the seedy kind. The Leren, another tropical American vegetable that has failed to find its way to Philippine Islands, is prepared and served like the seedy breadfruit. Finally there are 18 recipes for the cassava, and 16 for serving Malanga, the Porto Rican musical equivalent for the Philippine Gabi and the Hawaiian Taro. Both the last mentioned bulletins contain many bibliographical references that add to their value. All are eminently practical and are recommended to everybody who wants to know about more and better ways of eating and preserving locally grown tropical foods, and the authors are to be congratulated to their excellent beginnings, a word advisedly used, for it is hoped that these first publications will be followed by a series of others until all the food plants in their respective countries have been covered.

P. J. W.

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